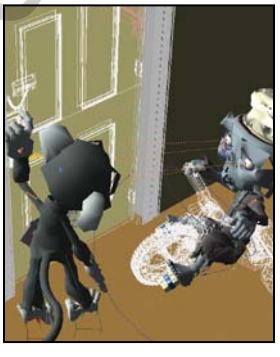
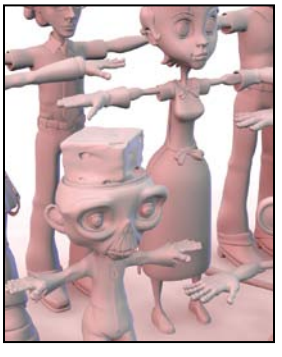
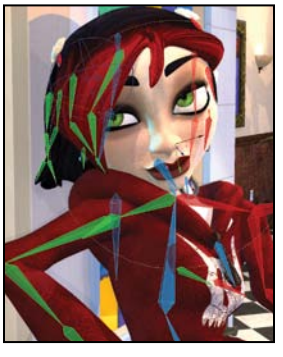
Understanding a Modeler's Role

To truly master digital modeling, you must be aware of all aspects of production and understand how they are connected. Before I start discussing the modeling process, let's explore the role of a digital modeler in a production environment. With a little help from some of my professional colleagues, I'll also talk about how your work directly affects the other stages and players involved.

It's all about teamwork: In soccer, for example, an individual player can be a skilled star and may be able to outplay many of the defenders on the opposing side, but his skill is greatly enhanced by his team members. They assist by making great passes to set up goals, defending against attacks, and working together to capitalize on every break to turn a game around. One player alone cannot win a game. Individual players may have flashes of genius, but working as a group and knowing the strengths of your teammates is the way to win. As players help enhance the stars of a team by supporting their individual skills, the team works together to reach an end goal.

Projects that require digital modeling come in all shapes and sizes, and can require a team made up of just one artist or hundreds of artists. Working closely with and understanding the needs of your team can only elevate the quality of the texturing, lighting, and animation of your digital models. CG artists at Inhance Digital (**Figure 2.1**), for example, work as a team to accomplish the many tasks that move a single project towards a unified goal.

[Figure 2.1] CG artists at Inhance Digital work as a team to accomplish many individual tasks that move a single project towards a unified goal.

A successful production team is made up of skilled artists who share common goals and a common vision, and have some level of interdependence that requires them to interact with the other members of the production team. The deliverables of each team member may differ, but the means by which each gets there is the same: teamwork!

Production Pipelines: Stages of Production

Depending on the nature and scope of the project, you need to decide the path and schedule that the production will follow from the initial idea to the finished product. This is called a *production pipeline*.

You can liken a production pipeline to a car assembly line. It optimizes production by arranging tasks in a specific order and so that they may be completed before moving on to the next stage. Going back and forth between stages can delay production, leading to a potential missed deadline and blown budget, both of which are frowned upon by all players involved.

A production pipeline for most projects can be broken down into three stages: pre-production, production, and post-production.

These stages are then distributed among several departments, depending on the type of project and what the final delivery method is. No two studios have the same process, but the following are common departments for animation:

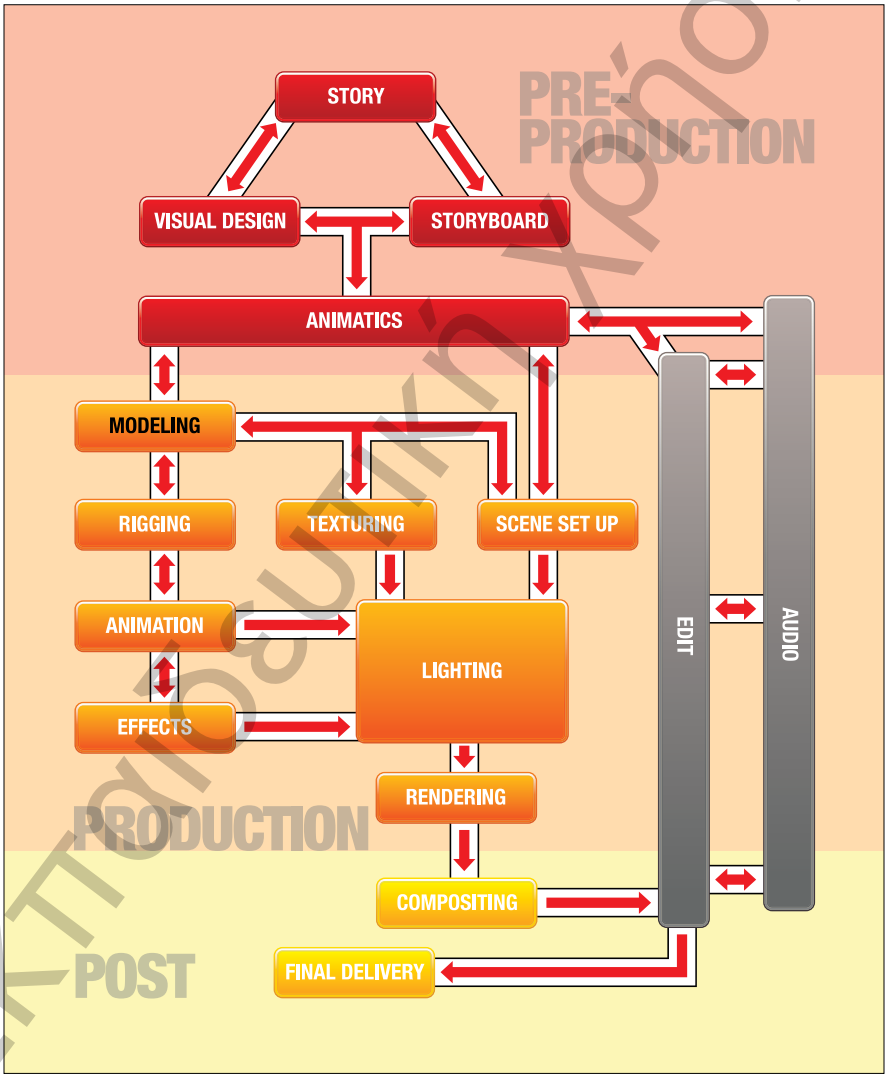
- Story
- Visual design
- Storyboard
- Edit
- Audio
- Modeling
- Scene setup
- Texturing
- Rigging
- Animation
- Effects
- Lighting
- Rendering
- Compositing

Incorporating the insights of numerous industry professionals, I discuss each of these in this chapter, and detail how a modeler works with these departments.

If you're the only person working on a project, you are responsible for carrying the workload of all departments for all three stages of production. Larger projects require the collaboration of multiple players, blending the talents and skill sets of the team to produce what would otherwise be a daunting task for an individual. It's important to note that no matter the size of the team or project, you will need a strong production pipeline.

Although every project will go through all three stages of the production process, not every project that you generate digital models for will require all components. A 3D print graphic may not require rigging and animation, for example, whereas real-time 3D games typically do not require the rendering and compositing of image files.

To give you the general concept of where a digital modeler fits into an average project, I'll use the common production pipeline of an animated short as an example. **Figure 2.2** shows a graphical representation of this type of production pipeline.



[Figure 2.2] An animated short's production pipeline involves many stages before its final delivery. This graphic shows where a digital modeler fits into the big picture.

I've called on the expertise and words of several industry professionals whose personal advice is printed throughout this chapter. You may not understand all the terminology they use, and that's OK. If you don't now, you will by the time you've finished reading this book. I encourage you to revisit this chapter after you have completed the other chapters, even if it is just to see how much more you know about these topics.

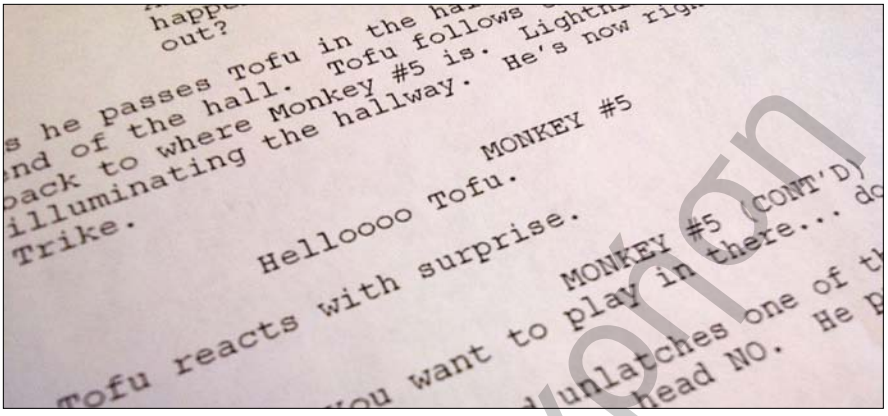
Stage 1: Pre-production

The pre-production stage is the process of preparing all the elements involved in a production and is the foundation of the project—the blueprint of the entire animation. The story and visual look of a project is developed at this stage, as well as the overall planning of the production. Any shortcuts taken at this stage of the game can directly affect whether a project will be a success or not.

Story

After the initial concept has been approved or decided upon, *writers* develop the story in the form of a script or screenplay. Story is critical. It's my opinion that the success of Pixar films is directly influenced by the fact that it is a story-driven animation studio. The highest production values cannot save a project with an inadequate story. Without a solid story, there are only elements thrown randomly at the screen, leaving the viewer confused, bored, and in most cases, unsatisfied.

In all the stories that I've helped to write, including the award-winning animated short *Tofu the Vegan Zombie: Zombie Dearest* (www.tofutheveganzombie.com/movie), I've found it very useful to use sticky notes during this process to construct a timeline based on key moments in the story. Each sticky note has story points that make it easy to change the order within the timeline. When you're satisfied with the order, you have a solid outline to begin writing your script. **Figure 2.3** is a snapshot of the script from *Tofu the Vegan Zombie: Zombie Dearest*.



[Figure 2.3] Story is everything. Without a strong story, a project is doomed from the start.

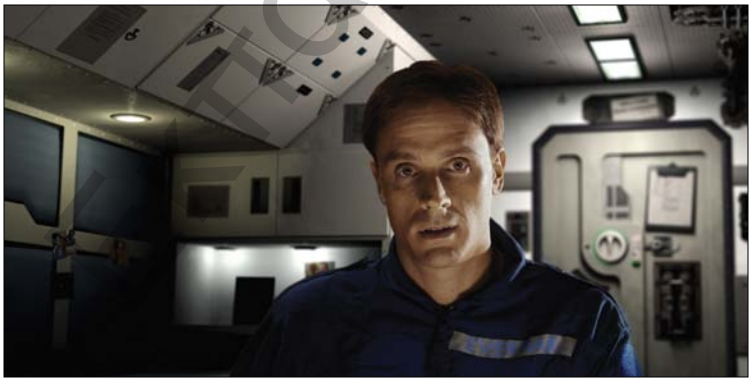
Industry Insight Alan Chan

Writer/director Alan Chan shares his thoughts on the story development process:

> Having worked on feature films such as *Green Lantern*, *Alice in Wonderland*, and *Beowulf* over the years, I've always kept my focus on staying true to the director's vision.
>
> Before it exists anywhere else, the story lives in the director's head. A good director should have the entire movie already playing in the theater of the mind, and the director's job is, quite simply, to transpose what he sees in his mind onto the screen. Having directed indie features and award-winning short films, I can tell you that this is easier than it sounds.
>
> The first step in this process is the development of the screenplay. When we developed the screenplay for our short film *Postcards from the Future*, we knew only that we wanted to share the wonder and inspiration of space exploration with the audience from a human perspective. From this we developed the perspective of the storyline, which was to tell the story from the point of view of an engineer sending video postcards to his wife back on Earth. It is from this seed of the idea that we then develop the world that our story will inhabit. Since this world does not yet exist, it is up to the modeler to build it. **Figure 2.4** shows a basic breakdown of a shot from *Postcards*, including the virtual set created by a digital modeler.

[Figure 2.4] Director Alan Chan confers with actor Robb Hughes on the set of *Postcards from the Future.*

A 3D virtual set was created by digital artists…



…and composited together for the final shot.

As a director and visual effects artist, I've had a chance to experience the production pipeline from various positions on the production chain. My role as a director requires that I work closely with the modeling and visual development team to create a world that holds true to the spirit of the story.

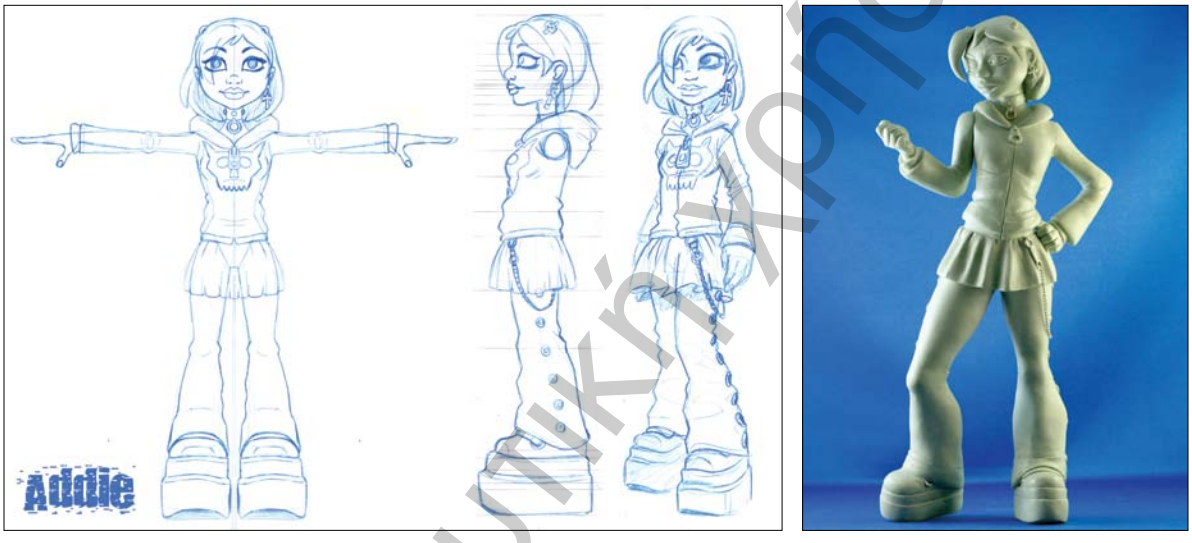
The modeler's role in this context is to help the director design and shape the characters and the stage on which the story will take place. To do so, the modeler must understand the needs of the story and ensure that the models fit together in look and spirit to create a believable world for the director to work in."

Visual Design

The *director* works closely with the *art director* to develop concept art for all elements in the production. Working under the art director's supervision, concept artists in the Visual Design department create multiple versions of these elements, which usually include characters, props, environments, and any asset that will need to be created during the production stage. **Figure 2.5** shows just a portion of the material artists created for the award-winning *Teddy Scares* animated short (www.teddyscares.com/movie).

[Figure 2.5] The production crew worked from an extensive collection of resources on the *Teddy Scares* animated short, including the collectible plush bears of each of the main characters.

Visual designs are usually in the form of traditional sketches and paintings, as well as clay sculptures, often referred to as *maquettes*. These designs begin loosely and are refined over time, and turned into model sheets for the modeling and texture departments. **Figure 2.6** shows examples of a model sheet and maquette from the film *Zombie Dearest*.

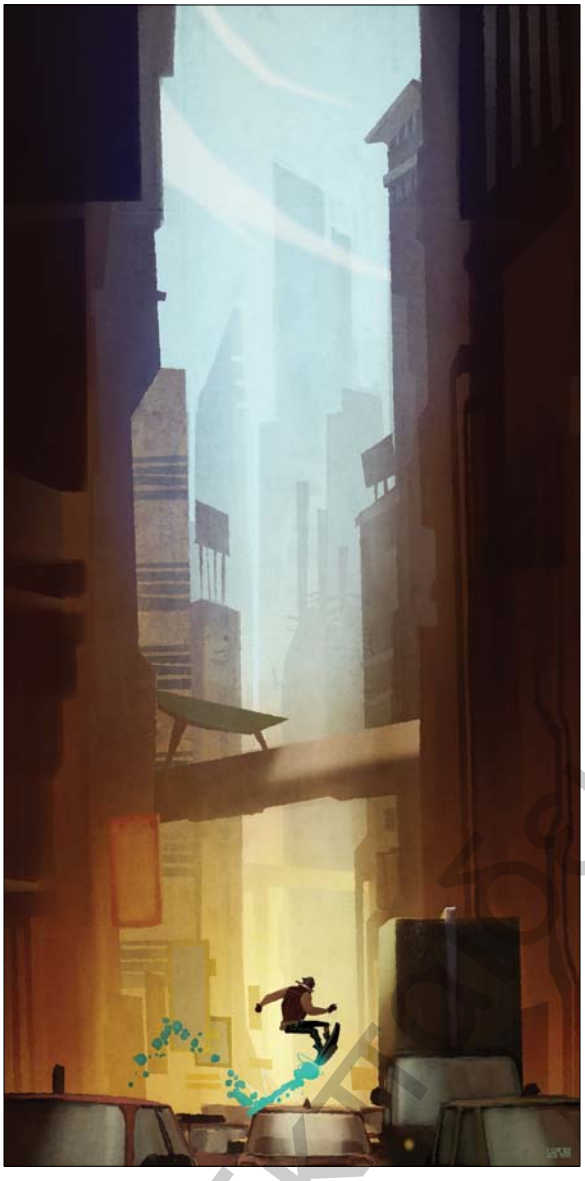


[Figure 2.6] A model sheet of the character Addie from *Zombie Dearest* was passed off to the modeling artist as reference (left). A physical maquette of Addie was sculpted by toy sculptor Rocco Tartamella as additional reference.

Industry Insight Kory Heinzen

Kory Heinzen is a visual development artist for TV, film, and games. **Figure 2.7** (on the following page) shows an example of how Kory might visualize a scene in a movie. He has this to say about visual design:

> A visual development artist can go by many names, including *production illustrator*, *concept artist*, *sketch artist*, *color stylist*, or even *viz-dev artist* for short. No matter what we are called, it is our job to bring into the visual world what has only been described in a script.
>
> When a scene is in the early days of pre-production, or the "blue sky" phase, where there are no crazy ideas and there are lots of artistic exploration and research. That's the honeymoon.



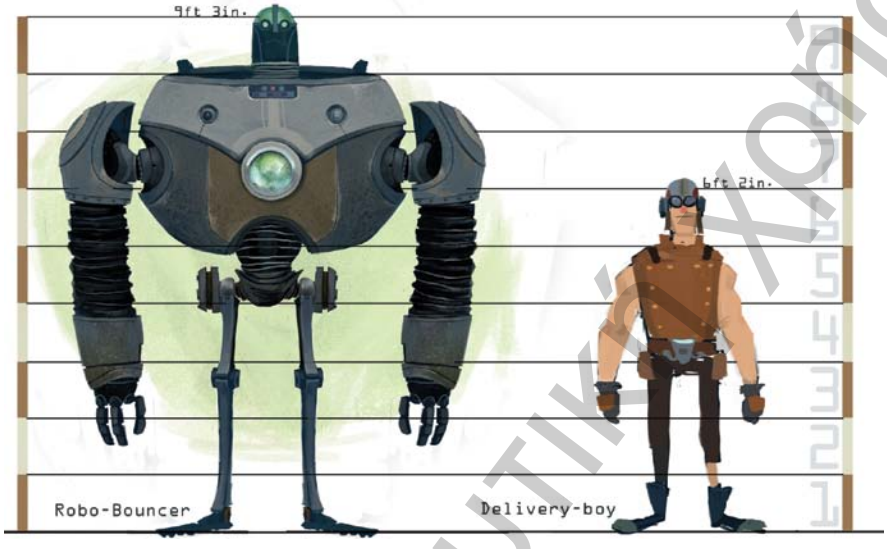
[Figure 2.7] This location study from Kory's animated project *Retro-Active* is an example of the first visual stage of a production.

There comes a point where some practical things need to happen in order to actually make a movie. Character designs need to be finalized, sets and props need to be designed, and color and lighting theories have to be conceived and approved. There are a lot of ducks to get in a row before things can go into production, and it's our job to help the production designer, art director, producers, and director answer the big questions before anything starts.

Films can be green-lit or sent back into development hell. Production budgets can be increased or decreased, characters can be cut or made into stars, and entire sequences can be thrown out or expanded; all of this is based on what we illustrate.

When working on the *Shrek* and *Madagascar* series of films, if I could turn my concept-to-onscreen ratio into a batting average, I would have been sent to the minor leagues. But that's not the point. Meticulously designing a set for three weeks is still cheaper than sending a bad idea into production where dozens or even hundreds of people will work on it. Our ideas are expendable; it's up to us to never run out of them. Simply put, changes are a normal and expected part of production. Ideally, changes are minimized, but there is just no way to avoid them in the creative process. Knowing this will save lives or at least your sanity.

Once a movie is moved into production, the art department is still working ahead of the other departments, feeding them more specific designs that are needed. Typically, characters at a stage like those in **Figure 2.8** are the first to go into production.



[Figure 2.8] Two character concepts from *Retro-Active*.

In my experience, characters are the hardest to do and take the longest to get approved. There is often a close collaboration between the character designer, modeler, rigger, and texture artist during this point in the process, with frequent input from the director. The transition from 2D to 3D is not always smooth.

There are some designs, especially "cartoony" or stylized ones, that can prove to be nearly impossible to achieve in 3D. Modeling straight from a drawing can be a disaster. Once perspective is introduced, proportions change and what looked good on the page is no longer appealing. A gifted modeler that can translate the feeling of a design is invaluable.

Sometimes there are modelers in the art department. These half-designer/half-modelers can work on designing sets or help create rough assets for previsualization or animatics. One thing to keep in mind if you find yourself in this type of position is to know how your model will be used. Typically, film assets can be amazingly detailed. But for pre-vis and set design, I approach it more like creating a game asset where I rely more on textures than geometry for the details. This keeps the models light for quick changes and helps to increase the interactive speed for the animatic artists. Once the cameras and the designs are locked, the models can be passed on as reference for the final models.

When designs are ready to be passed on, most likely there will be some sort of kick off meeting, formal or informal, where the art directors or directors explain the ideas behind the set and what they hope to see. Modelers receive a "model pack" for a set or location. Individual modelers are assigned props and environments to create. The art department will have broken out props and set designs—pages and pages of illustrations of everything associated with a particular location from the biggest building to the smallest grain of sand. Although there has been a handoff, this is by no means the last you will see of the art director or concept artist. In some studios, you will interact with the art director exclusively or sometimes the artist who did the original design. You will work closely with them to bring the designs to life.

Having worked on games like *Uncharted* and *Uncharted 2* and in TV and film as a concept artist and art director for over 15 years, I can tell you that it never stops being a magical experience when I see a design of mine given dimension by a skilled modeler. Seeing that first turnaround of something as simple as a minor prop still sends a bit of electricity down my spine. The best relationships you can forge at a studio are when you are working with other artists who just seem to "get it." Ask questions and always be willing to make it better.

Storyboard

With the script approved, the director will work with *story artists* to continue to flesh out the story in the form of *storyboards*, or sequences of images that help previsualize the story. **Figure 2.9** shows a storyboard sequence from the animated *Sifaka World* pilot. The storyboarding process, in its form today, was developed at the Walt Disney Studio during the early 1930s.

[Figure 2.9] The storyboards created for the *Sifaka World* pilot became the blueprint for the team to work from.

Storyboards are more than just sketches of what is described in the script. They play a role in how shots are framed and can help set the pace of the entire animation. I often direct artists to refer back to the storyboards during a production to ensure that they don't stray too far from the original goal. **Figure 2.10** is a photo of me talking over the opening shot with one of the crew, taken during the production of the animated short *Runners*. Some of the best elements of any story are conceived during this stage of production. Skipping the storyboarding stage can prevent you from further refining the story and can delay production.

[Figure 2.10] Storyboards are very similar to comic books, and in the case of the *Runners* animated short, we actually used the *Runners* comic book as our original storyboards.

Industry Insight Joe DiDomenico

Joe DiDomenico, art director at Applehead Factory, shares some insight on storyboarding:

> First and foremost, my job is to aid the director, to see his vision become a reality.
>
> When a team of artists is working on an animation, it is impossible to get started animating from the script alone. Animation relies heavily on the storyboard process: These drawings help to organize the story and match the visuals to the scenes within the written script. A storyboard is a visual shot-by-shot representation of a script, created in a series of panels that show the concept of the sequence of action, staging, and camera shots.
>
> Beyond what is written, a storyboard artist fleshes out what isn't on the page. I become a writer, artist, and actor all in one. I add visual puns in expressions and actions. I create action in a story when the script is vague. Storyboards help to cut production costs by giving production teams a

better way to understand fights, stunts, the timing of a comedic gag, special effects, and anything else that involves costly and complicated parts of a production.

I put together something that looks like a comic book of the entire film, scene by scene. This art becomes the basis of the whole production process that will follow. A storyboard is really just a foundation—a 2D blueprint. It isn't exactly how the movie is made, but it becomes a guide for what a scene may look like before it's animated.

Some people confuse storyboards with a series of illustrations. It's important to understand that storyboards speak more to the content within the frame than the drawing itself. My job isn't to "render" each frame, but instead try to capture a moment. I need to consider the framing or length of the shot, the angle of the shot, and if there is any movement involved. Usually, color is unnecessary for 99 percent of all boards (unless you are in advertising).

Also, having too much attachment to a sequence or to any one drawing makes for a bad storyboard artist. Everything changes; your best ideas can be thrown out at the drop of a hat. Because of that, when working in this medium, it is important to be able to draw quickly.

It is also extremely important to know the ins and outs of film terminology as a storyboard artist. You need to know the difference between a *cut-in* and a *cutaway*, to avoid crossing the line, and to know the psychology of different camera angles.

In storyboarding the biggest assets are the ability to draw quickly and equally as important, clearly. This job is simply one of visual communication.

Audio: Scratch Voice Recording

Before moving on to the animatic phases of pre-production, temporary voices called *scratch tracks* or *scratch voices* are recorded by the audio department. These are just stand-in voices performed by any willing member of the production crew.

Scratch voices provide the director and editor with placeholders for the final dialogue. They can also be useful in testing how shots play out with audio before committing to final dialogue and the pacing of scenes.

Although scratch voices are almost always replaced later in production, sometimes they don't need to be. If the director enjoys one of these early performances enough, the scratch voice could end up being used in the final. 3D artist Greg Young, shown in **Figure 2.11**, recorded a scratch track for one of the characters in *Runners* and later went on to do the same role for the final performance used in the movie.

[Figure 2.11] 3D artist Greg Young recording a scratch track of one of the characters for the *Runners* animated short.

One of my favorite examples of scratch track casting is Pixar's *Ratatouille* for which Lou Romano, a production designer at Pixar, provided the scratch voice for Linguini. Later it was decided that he would be cast as the character. Lou wasn't alone. Peter Sohn, a storyboard artist and animator for *Ratatouille*, was asked to do a scratch track for the character Emile (Remy's brother), and the directors liked it so much they decided to keep it in the movie.

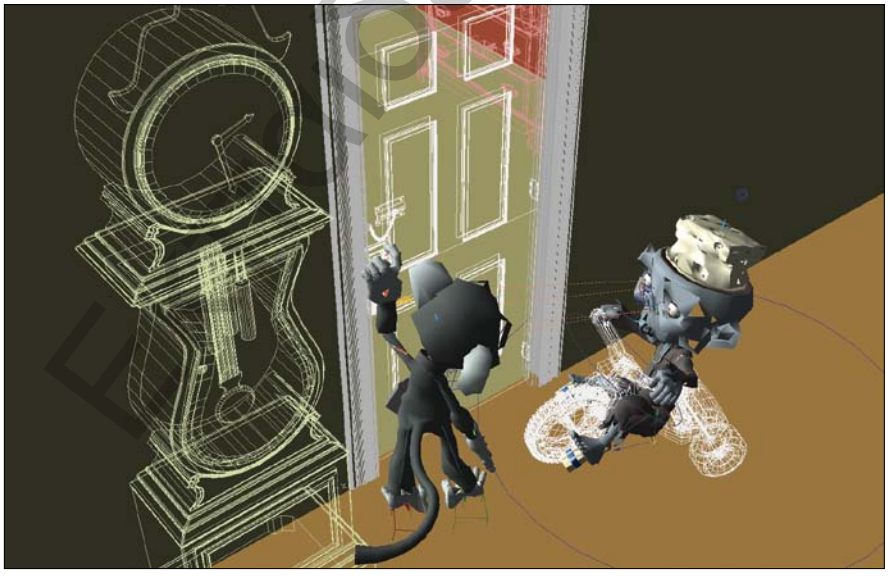
Animatics

Using previously approved storyboards and scratch tracks, an *editor* works directly with the director to create a story reel, or animatic. An *animatic* is basically a 2D preview of the entire film. The pacing of the story and the story itself are still being refined at this time. The entire movie can then be screened in this format to ensure that all of the story elements work as a whole.

Animatics allow the director to experiment and work out any issues with the story before things get costly. Animation is a time-consuming and expensive process, and this phase of production allows for all levels of changes at little or no cost. It is important to know that if a movie doesn't work in this raw 2D format, no amount of CG polish will help.

Once the 2D animatic has been approved and locked, *layout artists* begin constructing a 3D animatic while working alongside the director. This is yet another level of the story that is refined to ensure that the project has a strong foundation to build on before production begins.

The layout artist places and animates a 3D camera and works with low-resolution, temporary models called *proxy models*. **Figure 2.12** shows a 3D animatic scene using proxy objects as placeholders for the animated short *Zombie Dearest*. Depending on the production pipeline, these proxy models are either created by the layout artist or artists in the modeling department.



[Figure 2.12] This 3D animatic scene from *Zombie Dearest* shows an example of several proxy objects.

Industry Insight Aristomenis Tsirbas

Aristomenis Tsirbas, director and founder of MeniThings, offers more insight on animatics:

> This is where the 2D story reel is given a new dimension (literally) and becomes the template for 3D production. From my experience working both on my own films and for other directors, there are essentially two ways you can approach animatic modeling: stand alone or integrated.
>
> The stand-alone approach is typically used in pre-visualization houses and large productions with separate animatic divisions. Here modelers work from the production designs to create models and environments that are light enough to be manipulated in real time with the director present. The modeler needs to be fast, and the results need to look good and read clearly. But since these models won't be used in production, the modeler is free to take shortcuts and spare things like micro-bevels and proper topology flow. The best layout modelers know how to cheat expensive things like smoke and water, and need to be open to frequent and often radical changes on the fly. Also needed is a decent grasp of basic rigging and texturing since animatic teams are often small and value artists with multiple skill sets. The key here is speed and flexibility. Since this is still technically the story stage, everything is up for change, so the modeler needs to keep up with this hectic but very creative part of the pipeline.
>
> The alternative is a method I use for many of my projects. It involves an integrated approach where each model is essentially the first pass of the final asset. In other words, whatever model is created for the animatic is carried over and continued to be worked on into production. This way the animatic models, environment, lighting, and camera all represent the groundwork for each final shot. This approach requires all the skills of the preceding method with the exception that all animatic models must have clean, continuous geometry that can be polished to final production quality. It represents a bit of extra work, but in the long run can save huge amounts of time because modeling work isn't done twice.
>
> In either case this can be the most enjoyable and creatively rewarding form of modeling, since it affords the artist the ability to produce more models in less time with less fussing over the small stuff.

Audio: Voice Recording

At the voice recording stage of production, the story and animatics have been locked, and the producer and director should already have actors cast for all the voices.

As shown in **Figure 2.13**, each actor is recorded separately—although I have found that it is helpful to schedule the voice talent recording so that the actors can interact with each other before they perform.

[Figure 2.13] Actor Dave Shoemaker records final audio at Sound-o-Rama in Orlando, Florida.

For the *Teddy Scares* animated short I directed, it was fun having Rick Baker, Clive Barker, and Linda Blair all in the same place for a short time before the recording took place. It gave them a moment to relax and meet the other players.

Once recorded, the voices are later assembled into the edit so that the timing can be locked, and the audio files are delivered to the animators.

These recordings directly influence the timing in the scenes and help drive the performance the animators will create in the final frames of the animation. It can be extremely helpful to record video of the voice recording sessions to help aid the animators when they are trying to capture the characters' expressions at key moments.

Stage 2: Production

The production phase of the project is where final elements of the animation are initially created based on the work developed by the pre-production crew. It is the production crew's job to stay true to the blueprint in place and to maintain the director's vision. It's also where the digital modeler comes into play in most production pipelines.

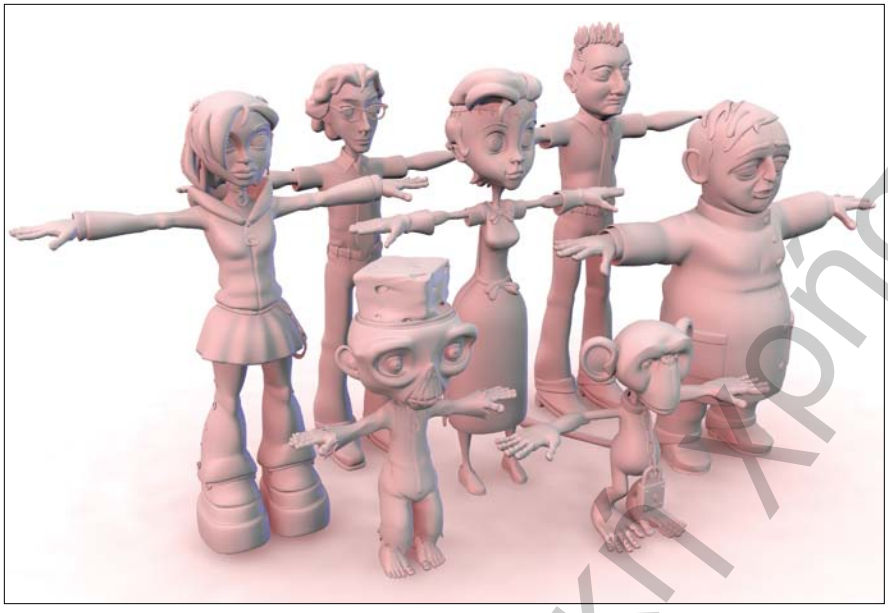
Modeling

You didn't think I'd ever get to you, but here we are. Although you've had to wait your turn, believe me, it's definitely worth the wait. The longer it takes to get to this stage of production, the more likely you will be generating digital models for a successful project.

Modelers work under the art director and/or a *modeling supervisor* to generate the 3D models for all elements of the project based on the model sheets (refer to Figure 2.6) created by the visual design department.

Modelers are responsible for the delivery of production-ready *meshes* (also called 3D models) that are ready to be rigged and textured by the other departments. This involves open communication between departments to ensure as little back and forth as possible takes place. Having a model sent back to the modeling department due to issues with the mesh can delay the production, which in turn could lead to a missed deadline. **Figure 2.14** shows the entire cast of *Zombie Dearest* modeled and ready for the other departments to take over.

Depending on the type of work or studio you want to be involved with as a modeler, you may be required to handle multiple stages in the pipeline. Some studios don't have a modeling department. Instead, they have *technical directors* (TDs) that create the models and then see them through to articulation (rigging). As TD, you may also be required to generate UV maps (2D texture coordinates for points) for the texture department, weight maps (a value that defines a bone's influence on a point) for the rigging department, and selection sets (which store a single state of a point, either selected or not selected) for the effects department.



[Figure 2.14] The *Zombie Dearest* character models were modeled and prepped before they went to the next stage in the production pipeline.

Industry Insight Glen Southern

Glen Southern, 3D artist specializing in creature and character creation and the managing director and creative director at SouthernGFX Limited, explains how a 3D modeler is an essential part of any CG production pipeline:

> The 3D modeler is one of the pillars that supports any CG project. To be successful in the role, a modeler needs to be flexible, adaptable, thick-skinned, assertive, a team player, and much more. As one of the primary creative roles in most pipelines, the modeler generally takes his steer from a 2D concept artist who has usually created a set of images defined by an art director. Whether it is for games, film, or TV, the modeler is generally given very specific turnaround images, or accurate side, top, and front profiles to match. It then falls on the modeler to accurately create the required model. Depending on the size of the team, the modeler could also be asked to give the model a set of UV coordinates and possibly even create all the required texture maps.

With advancements in modeling software, a lot of modern digital modelers are required to sculpt a model to a high level of detail in programs like ZBrush or Mudbox. They may then have to re-create the entire model again with better polygon flow for animation using retopology tools. Whether the project dictates that you start a model by box modeling a base mesh or sculpting a high-frequency mesh, you must always be thinking ahead and problem solving on multiple levels.

Taking feedback and criticism from art directors and technical directors is a skill in itself. When you are an integral part of a pipeline, you will at some point have your work critiqued. It is important to keep in mind that you don't always receive positive feedback. What you may think is a fantastic piece of work may have missed the mark in some way and may need revising. In extreme cases the work will need to be shelved and something new created in its place. This is perfectly normal in most projects. The skill comes in taking the feedback onboard and understanding why the changes were necessary. Asking the right questions before ever beginning to model can minimize issues like this, but changes do happen regularly on live projects.

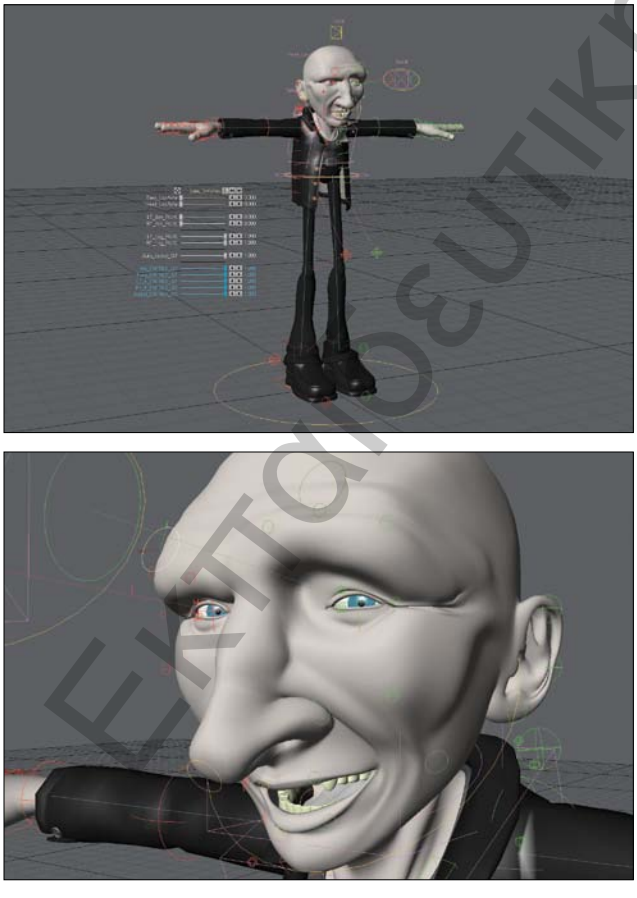
Also, well-planned and laid-out 3D models are easier to unwrap in a UV package. If your model is a mess of badly laid out polygons, it may look OK when subdivided, but when you unwrap it, there could be problems. Another important stage further down the line is the rigging of a character. As a 3D modeler, it is essential that you have a solid understanding of good topology, primarily because good topology allows a rigger to efficiently rig and weight a model for animation. Creating amazing-looking models is one thing; creating amazing looking characters that deform well and have all their joints working correctly is quite another. The best 3D modelers can all rig. This gives them the understanding of where to put accurate edge loops.

Although the 3D modeler begins early on in the production pipeline, good communication between the different disciplines is essential. As I've mentioned, the modeler sits between the concept artist and the artists doing the texturing and the rigging. Technical directors and programmers will also have a say in a model's creation; they will be handling things like dynamic cloth, hair, muscles, liquids, fur, particles, and lighting. The modeler needs to have good communication skills, and this is where being a team player is crucial. If you don't keep those lines of communication open, there will be bottlenecks and you really don't want to be the cause of that delay.

Rigging

Once models have been created and approved by the director, the assets move to the rigging department where *character technical directors* or *rigging artists* design and create rigs (bones and controls) for characters and any other model that requires any form of animation or effect.

If modelers have delivered efficient work, they have given full support to the rigging department and, in turn, will have helped keep the production on schedule and within budget. The rigging artist does justice to the modeler's work by giving the animators the tools to turn a statue of an object into something that can move and react to its environment. **Figure 2.15** shows an example of a rigged character with both body and face controls for the animators to pose the mesh with.



[Figure 2.15] This rigged character gives animators control of the body (top) as well as the face (bottom) with easy-to-use controls.

Industry Insight Kurt Smith

Kurt Smith, a rigging artist at Pixomondo explains rigging further:

> As a rigging artist working on shows like *Terra Nova*, my role is to create the hidden mechanics that drive the models animated by the animation department. As a rigger in a production pipeline, my goal is to quickly and efficiently create powerful and highly responsive rigs. An important part of what I do is talking with the animators to make sure that they have the functionality they will need to animate. These conversations ensure that the model is deforming and moving in the way it was designed to.
>
> During any production, I am in constant contact with the other departments. Good communication is essential to the success of any production. This is especially true when the rigging department works with models. Dealing with modeling changes, ensuring that the model has working topology, and that the rigging department will be able to achieve good deformation on the model means the modeler and rigger must be communicating back and forth as much as possible.
>
> Two key areas a modeler should be mindful of are *clean topology* and a *proper base pose*.
>
> **Clean topology:** It is crucial that a model has excellent topology before it is delivered to the rigging department. This means that the modeler must have an understanding of what makes for good poly flow and has an acute attention to detail. Having an accurate understanding of anatomy and how muscle structures work (in both humans and animals) is an extremely useful tool in a professional modeler's toolkit. Without good poly flow, the model will never deform properly regardless of how much time and effort the rigger puts in to make up for an inefficient mesh.
>
> A modeler can help the rigging department achieve good deformations in more ways than having a working polygon flow. There are some simple adjustments that can make a model a rigger's dream to work with. Avoiding stars (a point with five or more polygons connected to it) in areas that have a wide range of motion is desirable for good deformations.

In hinge joints, such as the elbows and knees of a character, if the "rule of three" is modeled so that the outside edges are angled wider where the bend occurs (the inside of an elbow) and thinner on the opposite end of he joint (the outside of an elbow), the deformation and intersection in those areas becomes better without much effort on the modeler or rigger's part.

Proper base pose: It is also extremely important that a modeler understands what makes a good base pose to send to the rigging department. The model should be resting on the ground plane, centered on the origin, and facing forward. For characters, the base pose that is most often used for rigging is the T-pose, although a rigger might ask for the relaxed pose instead. It is important to have a discussion before committing to one setup or another.

Having a good base pose also means the modeler must make sure that the scale of the model is accurate before handing it off to the rigger. If a base pose is out of place or scaled incorrectly, the rig may have a broken rotation axis or bad deformation and may be extremely difficult for the animators to pose as a result, thus slowing down the entire pipeline.

Anyone interested in modeling for animation should have a basic knowledge of the rigging process. Modelers with an understanding of rigging will be able to diagnose and avoid potential problems as soon as they begin a model, which saves time and effort, and speeds up any production pipeline they are a part of.

In closing I'd like to add that it is just as important for a modeler to have an understanding of rigging as it is for me as a rigger to have an understanding of animation. To be honest, I think every artist should have an understanding of the entire production pipeline, as it will only make them better at their craft.

Scene Setup

As soon as models begin getting approved, either *layout artists* or *set decorators* will start populating the 3D animatic scenes with the final elements based on the concept art and animatics generated by the other departments. This is more than just a paint-by-numbers process; these skilled artists use a keen eye

to generate densely populated environments. **Figure 2.16** shows an example of finished models being placed in one of the locations in the *Zombie Dearest* animated short.

[Figure 2.16] This image shows the set decoration underway for Professor Vost's lab in *Zombie Dearest*.

Set decorators take a modeler's environmental models and give them a purpose.

Industry Insight Ed McDonough

Ed McDonough, digital artist at Rhythm + Hues Commercials' boX unit, talks about set decoration:

> As a layout artist, my responsibility is to take the models that are created for the environment (including buildings, vehicles, plants, and any prop items) and set them up to make the storyboard background come alive as much as possible in 3D space. My goal is to populate the scenes with objects that help make the backgrounds more believable, but not too distracting from the main action of the shot. This is done by either adding or adjusting details and props to help fill gaps in the scene or guide the eye to where you want the viewer to be looking. The addition or alteration of even one single rock could change the entire feeling of a shot in the sequence.

Using the storyboards and animatics as reference, I create a list of assets that are needed to mimic the initial animatic. Working with the modeling team, I populate the scene with all the necessary objects. This process goes through many phases during the progression of the project, including model adjustments or additions, taking into account any additional camera choreography changes that may show an alternate view of the set. The environment gets pieced together while trying to be as economical as possible with poly-count (the quantity of polygons that make up a 3D model). This is accomplished with the help of the modelers by supplying low-poly objects for some items in the far background along with models with multiple levels of detail (determined by the distance from the camera) that are able to be swapped out with the final meshes.

While working on the cinematics for the game *Saboteur*, the team was able to start out with some of the video game assets that were then converted for our use in the scenes. This helped by letting us start with all low-poly objects in the scene, and then after determining where the action would take place —including all the camera angles—the modelers were able to clean up the models and textures as needed to fit them into the environment. This was also the time to up-res any models or even remodel them for higher resolution using the original models as scale reference.

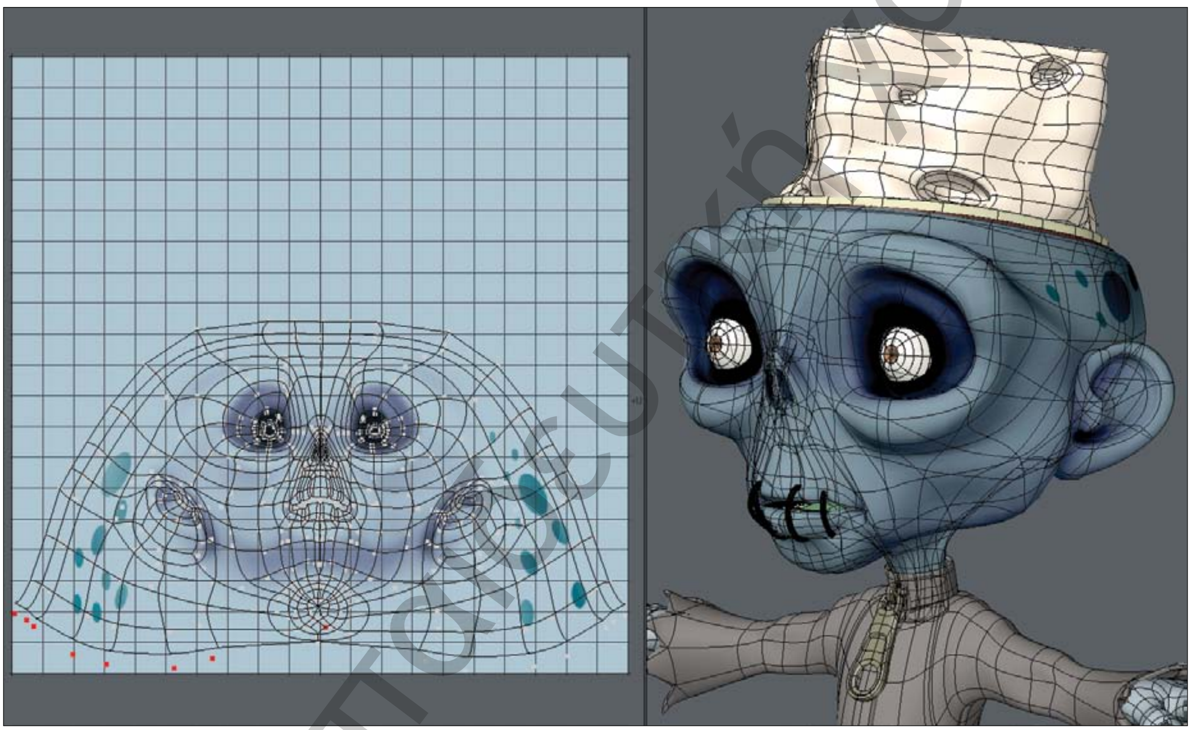
It has been my experience that layout artists tend to wear a lot of different hats throughout production, especially in smaller teams. This enables them to model, texture, and animate above and beyond the traditional set design responsibilities. Multitasking works well because the layout artist already has a vast knowledge of the sets and the props that occupy the area. While working on scene layout during the *Crackdown 2* trailer, I was also able to model and texture background assets to help fill the scenes, as well as create the camera choreography. The modelers supplied me with the main assets that were then propagated into the scenes. Before finishing the setup of the scene, the camera was positioned to show what areas of the environment needed more focus. It was very advantageous to be able to jump back and forth between roles, which made it more efficient for the fast turnaround of the trailer.

Communication between layout artists and modelers is a must. The layout artist may need a new model or an adjustment to a model at a moment's notice. Since at any time in production a new item could be required, the modeler's speed, time management, and efficiency are great resources.

Texturing

Using meshes generated by the modeling department, *texture artists* bring these cold, gray assets to life with detail and color.

Texture artists enhance the surfaces of models by generating texture maps from photographs, creating *shaders* that mimic real-world materials as well as customized textures that can only come from a creative imagination. **Figure 2.17** shows Tofu from *Zombie Dearest* (an animated short) receiving skin details courtesy of an image painted in Photoshop and applied using a UV map.



[Figure 2.17] Tofu gets his skin details courtesy of an image painted in Photoshop and applied using a UV map.

These highly skilled artists have mastered the art of observation. They have a keen eye for detail and the ability to reproduce materials based on the references they have been provided by the visual design department—or that they have gathered based on the direction they have been given by the director and art director.

Industry Insight Angel Nieves

Angel Nieves, now 3D Lead at MTM, has the following advice about texturing:

One of my many responsibilities at Hi-Rez Studios was working as a texture artist. This involved a variety of tasks, including:

- Unwrapping and laying out UVs
- Breaking out the mesh into multiple surfaces
- Outputting ambient occlusion and normal maps
- Painting texture maps for the various attributes of each surface
- Finalizing the textured mesh for the production

As a texture artist, I check every model for n-gons—polygons with five vertices or more. I also check for stray vertices and polys. Both can cause problems when unwrapping and later problems for the rigging, animation, and rendering departments. If any of those errors are found, the model is sent back to modeling to be fixed before texturing gets started.

Once a model is unwrapped and laid out, a texture artist begins the texture painting process: Diffuse, specular, reflection emissive, normal, and so forth are painted, and then a material is made out of every texture map.

Clean topology is essential for the texturing process as it gets rid of guess work concerning where to separate the mesh for unwrapping, which helps reduce or completely eliminate stretching and distortion in a model's texture. Mechanical meshes like robots, helicopters, and tanks are good examples of where a modeler can assist the texture department. Those kinds of assets usually have parts that a modeler has to duplicate and place correctly on the model.

It is more efficient for the modeler to unwrap one nut and bolt and then duplicate it as necessary than to have the texture artist unwrap each nut and bolt in the whole model, one at a time. If a modeler plans ahead for tasks like this, he can shave hours and sometimes days off of a texture artist's workload, which is always welcomed.

I would say to anyone who wants to become a professional digital modeler that it is essential to have UV unwrapping skills. Even if you don't create the UVs, it will give you insight on how the texture artist will proceed when

unwrapping the mesh. It also helps with replicated geometry, which directly affects the job of the texture artist.

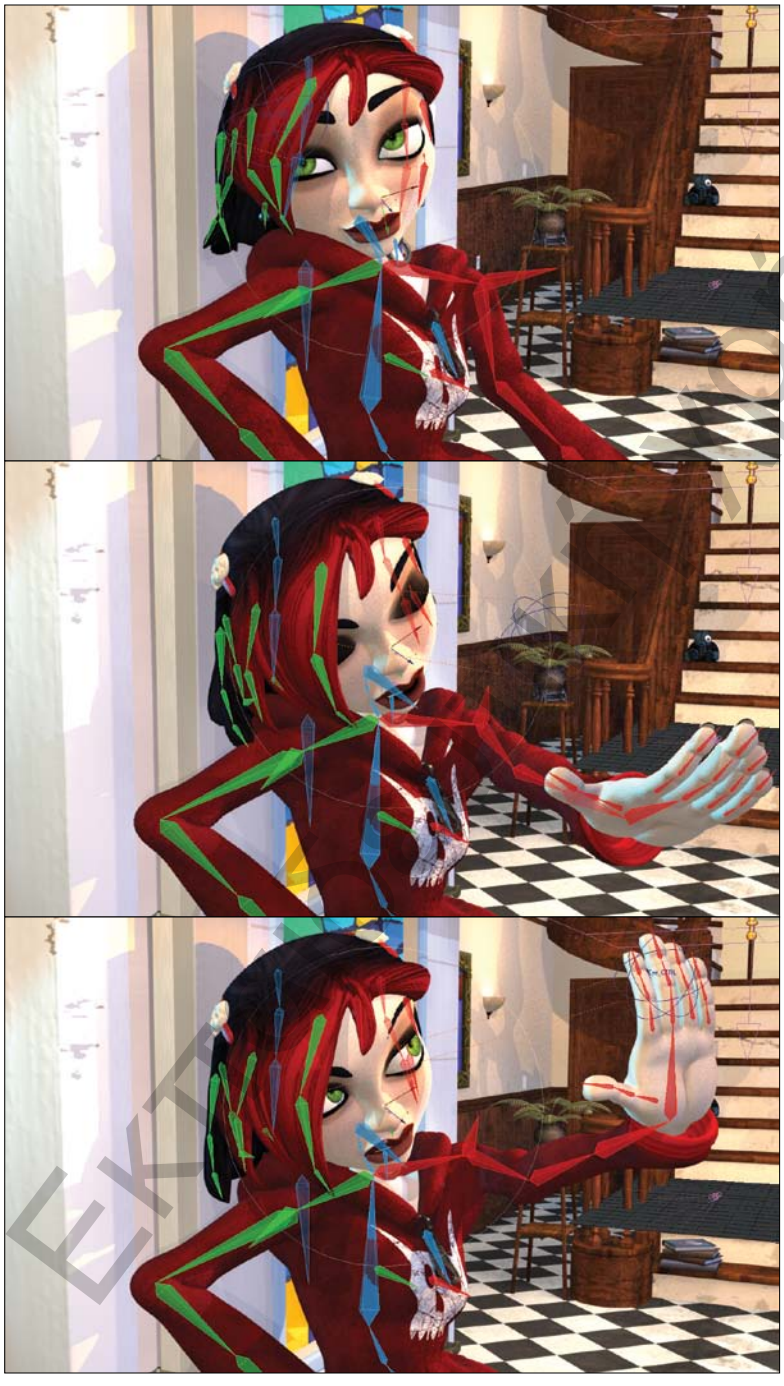
It is fundamental that communication between a modeler and texture artist is open and frequent throughout production; working together to find solutions allows both artists to be more efficient with their workloads. It saves time, money, and lots of unneeded headaches for every artist in the pipeline, and the resulting modeled assets will be at a higher level of quality.

Animation

Without a doubt, *animators* are the rock stars of the animation industry. Modelers should be their biggest fans, because the animation department breathes life into a modeler's otherwise lifeless mesh. The animation department, working with the handiwork of the rigging department, takes the assets generated by the modeling department and give them motion to tell the story.

Animators match the digital model's actions to the animatic and audio provided by the editor under the watchful eyes of the animation director and the director. **Figure 2.18** consists of three frames pulled from an animated sequence of Addie delivering dialogue in *Zombie Dearest*.

Just like the other artists within the production, animators work from reference materials like stills, video, and real-life observation such as studying the movement of people or animals. They not only deliver a character's movement, but the character's emotions as well, providing the illusion of life.



[Figure 2.18]
An animated sequence of Addie in *Zombie Dearest*.

Industry Insight Johnny Gordon

Johnny Gorden, founder and animation supervisor at Zero Gravity Entertainment, explains animation further:

> By the time a model reaches the animation department, it's been through a few check points and possibly back to the modeling department a few times already; so you might think that it's clear sailing from here. However, there are still some issues that present themselves in animation that are difficult to detect any earlier.
>
> The rigging team has checked the model, put it through a number of test poses, and tested facial expressions, but animators don't always play by the rules.
>
> As an animator, I often want the model to move in a way that the rigging team never imagined. This will inevitably create unforeseen problems, whether it's a pose that pushes the limits, an extreme facial expression, or a combination of facial expressions that weren't designed to go together.
>
> It is useful to understand what the different stages are for animating a scene:
>
> - Stage one is the layout, which is either done by a dedicated layout team or by the animation team. This stage usually uses temporary models, or stand-ins.
> - Stage two is the blocking stage. This is usually done with low-resolution representations of the models that can be posed quickly, or specially created segmented models that are parented to the joints.
>
> This enables the animator to work efficiently and play the scene at full speed. Because the final models aren't being used, problems aren't usually encountered in this stage.
>
> Depending on the needs of the production, the director or animation supervisor may require a check of the blocking using the final models before signing off to identify any problem areas as early as possible. The results of this check may identify some problems in the model or rig that need fixing.

- Stage three is facial animation and lip sync. This is often where the first problems are seen. The animator will create an expression that is too extreme or combines expressions that weren't tested together, and the model will tear or deform badly.
- Stage four is the final pass, including secondary animation, offsetting the timing of motions, and a final check to make sure there are no intersections. Usually by this stage, a few problems have already been caught, but a few more may be identified.

When problems appear during animation, the director or animation supervisor will decide whether to modify the animation to accommodate the limits of the model or rig, or to revise the model or rig.

Whether or not a modeler communicates directly with the animators can depend on the size of the production. Usually, if the model is to be revised, it is first sent to the rigging team to check whether it's the model or the rig at fault. If the model still needs revision, it will go back to the modeling team.

In some productions, the animation team will only go to the rigging team when there are problems. That way the rigging team can determine whether it's the rig or the model causing the problem, and only bring in the modeling team when necessary.

Effects

An *effects artist* creates all the non-model elements in an animation. These include things like hair fibers; elemental effects like water, fire, and smoke; as well as fabric dynamics. **Figure 2.19** shows an image sequence that an effects artist created of a Hummer being crushed by a robot character from the award-winning, animated short *Spoonman*. Many details had to be worked out to get the car's hood to cave in and the windows to blow out, making it a perfect task for a problem-solving effects artist.

[Figure 2.19] This sequence from Spoonman is an excellent example of a type of shot an effects artist would be tasked with.

Effects work is usually based on a performance-driven motion or event. To have the most impact, effects need to be lit a specific way as well. For these reasons, constant communication with the lighting and animation department is a very important part of this process.

Effects artists are elite problem solvers that help transform a mundane visual into the unforgettably spectacular experience.

Industry Insight Jarrod Davis

Emmy Award–winning, visual effects artist Jarrod Davis adds:

At the most basic level, an effects artist is responsible for animating all of the "other" things in a scene. It's the stuff that the primary animators don't handle—things like simulated effects for cloth or debris, smoke, fire, dust, or even water spray from a boat. Also included are effects that are added to the primary subject after the animation is finalized, like feathers or fur.

When working as an effects artist on shows like *Firefly*, *Battlestar Galactica*, and *Eureka*, the best gift I could receive from a modeler was nice, clean geometry. Like every other stage in the production pipeline, effects artists deal with departments both upstream and downstream from them. But there are a few areas that set effects apart and make it very reliant upon a modeler's skill and attention to detail.

Cleanliness: Often, the effects department will be called upon to take an asset and smash it to digital bits. And even though a model may have gone through the rigging and animation processes without problems there, slicing and dicing it into a thousand pieces can very easily expose hidden flaws. A good, clean poly-flow and efficient geometry with no extra or hidden stray pieces are a major boon to the effects artist.

Efficiency: I mentioned this before, but it's worth mentioning again, because much effects work revolves around simulation—often of particles, fluids, or other dynamics that can be extremely computationally intensive. The more geometry the computer has to push through the calculation, the longer the process takes. Now, you don't want to cut corners, but making sure that only what's actually needed is modeled is something you'll want to build up experience with. Also, the effects department will sometimes request low-polygon "hulls," simplified objects to use in simulations where the full level of detail for interaction is not required. Being able to make a low-polygon version of your master asset is another skill worth mastering.

Consistency: The simulations that the effects department handles are often physically based. This means, among other things, that units matter. Explosions that are 5 inches across behave very differently than those that are 50 feet across, and it will show in the work. Most modeling departments will require it, but even if yours doesn't, be in the habit of building your items to scale whenever possible. There's rarely a downside, and the major upside is that it will behave much better in every way, especially in an effects simulation.

The better a modeler understands how the mesh will be used by the effects department, the more efficient and clean the digital models will be, which makes for happy effects artists.

Lighting

In most pipelines, the *lighting technical directors* pull all of the elements from the pipeline to finish off the scene before they actually begin placing lights into the environment. Lighting plays a massive role in the final look of the production, setting the mood, color, and atmosphere of each shot. **Figure 2.20** shows a scene from *Teddy Scares* (an animated short) in which a lighting technical director is placing lights.

Lighting artists ensure that there is a consistency in lighting between shots, and that the final look of the animation matches the director's vision as defined by the visual design department.

The lighting department also works closely with the rendering and compositing departments to ensure that their elements are properly prepared for the next stage of production.

[Figure 2.20]
Lighting artists work in several display modes to place lights, including wireframe (top) and an interactive real-time preview (bottom).

Industry Insight Nicholas Boughen

A VFX supervisor at Method Studios, Nicholas Boughen shares his insight on lighting:

As a lighting artist, I have two areas of responsibility: technical and aesthetic.

My technical responsibilities involve:

- Ensuring that the desired elements of the scene are properly illuminated
- Fulfilling the requirements of time, place, and weather
- Ensuring continuity with other shots in the sequence

My aesthetic responsibilities include:

- Setting or supporting mood
- Assisting composition through lighting, such as determining viewer focus through variations in light intensity across the image

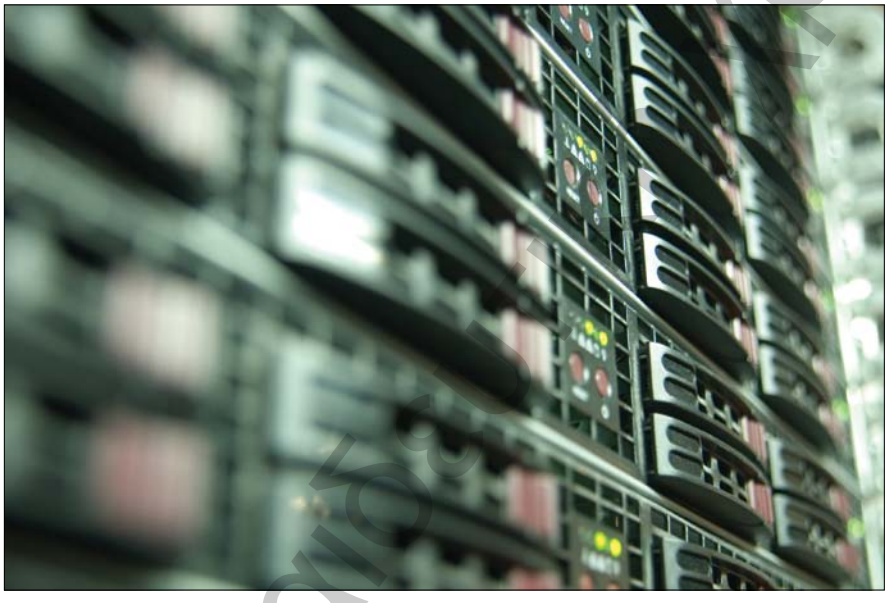
The true artistry comes through combining both the technical and aesthetic into a clear, powerful composition.

In my role as a visual effects/lighting supervisor, I deal with the modeling team almost every day. In the lighting department, lighting artists will sometimes discover errors or glitches in geometry that may not have been obvious at the modeling stage, such as light leaks, flipped normals, or edges that need a microbevel (a small beveled edge connecting two surfaces). Since the asset is public, it is not up to the lighting artists to make repairs; it must go back to modeling so they can make the fix and publish a new version to the studio. After this comes the lighting TD. The lighting TD is in charge of breaking down a shot into render layers, ensuring that the shot renders properly and within production specifications, such as render times and RAM usage. The lighting TD may ask for a model to be split up in certain ways to accommodate different render passes, such as mattes and holdouts.

The interaction between lighting and modeling is constant and fluid as we work together to create perfect shots.

Rendering

Render wranglers, also referred to as *queue managers*, take the approved final shots and break them out into individual passes that will allow compositors full control to refine the final look of the sequences. They then generate the final renders of all the combined passes for each shot, taking advantage of multiple render nodes (processors) that make up a render farm. Without these forgotten soldiers, there would be no movie. **Figure 2.21** shows just a small portion of the render nodes used at Inhance Digital to pull off amazing work on time and within budget.



[Figure 2.21] A close look at a few of the nodes that make up the render farm at Inhance Digital.

Industry Insight Farrah L. Welch

Render artist Farrah L. Welch provides an inside look at her time within the rendering pipeline on *Battlestar Galactica*:

> My core responsibility was to break out approved shots into individual passes and render them out for the compositors to reassemble.
>
> This started with replacing proxy geometry, lighting, and effects with the correct and final versions, and optimizing the scene so it would render as

quickly as possible without monopolizing the render farm. From there, I would break a shot into render layers, anticipating what the compositors needed in order to have maximum control over the final product. This included multiple diffuse, specular, reflection, refraction, effects, and matte passes for different lights and elements in the scene. Taking shot priority into account, I had to make sure that passes rendered correctly and in a timely manner, especially since a single shot could have 30 or more passes. I also maintained communication with the compositing department to facilitate corrections and make sure it had everything it needed to complete the shot as directed by the VFX supervisor.

I had to confer with the artists, compositors, coordinators, and supervisors to make sure that shots I was responsible for ran through the pipeline smoothly and on time. Each artist's role in the pipeline directly influenced my job on a daily basis, including the modeler. It was important for geometry to be clean and ready for production without holes, polygons on polygons, and other problems that would cause render errors, slowing down production and costing valuable stack time. Mesh density was very important as well. If the geometry was unnecessarily dense, render time would be too high, slowing down the entire pipeline. This often resulted in having to spend time cutting up models and removing detail unseen by the camera. If a model was faceted in-camera, lacking adequate detail, or had obvious UV seams, I would then either have to stop my work and take the time to fix it or send it back for repair.

All of these situations put a bottleneck in the pipeline and slow down production. Ideally, to minimize this bottleneck, models that will be reused again and again should have low, medium, and high-resolution versions with *nurnies* (small technical details added to break up the surface of an object to add visual interest) that are easily removable. Also, good naming convention is key! If someone has already spent time cutting up a model and removing detail, it needs to be saved in the correct location with an appropriate name so another artist doesn't waste valuable production time reproducing another version. Continuity between these versions is very important as well. If you have a low-res model and high-res model in back-to-back shots, they'd better look the same! You can't have a viper with battle damage in one shot and see it without a few seconds later. If you create high-quality models from the start and communicate effectively, you will

save valuable production time and make the others on your team happy by creating less work for them.

As a render artist, communication between different departments is essential.

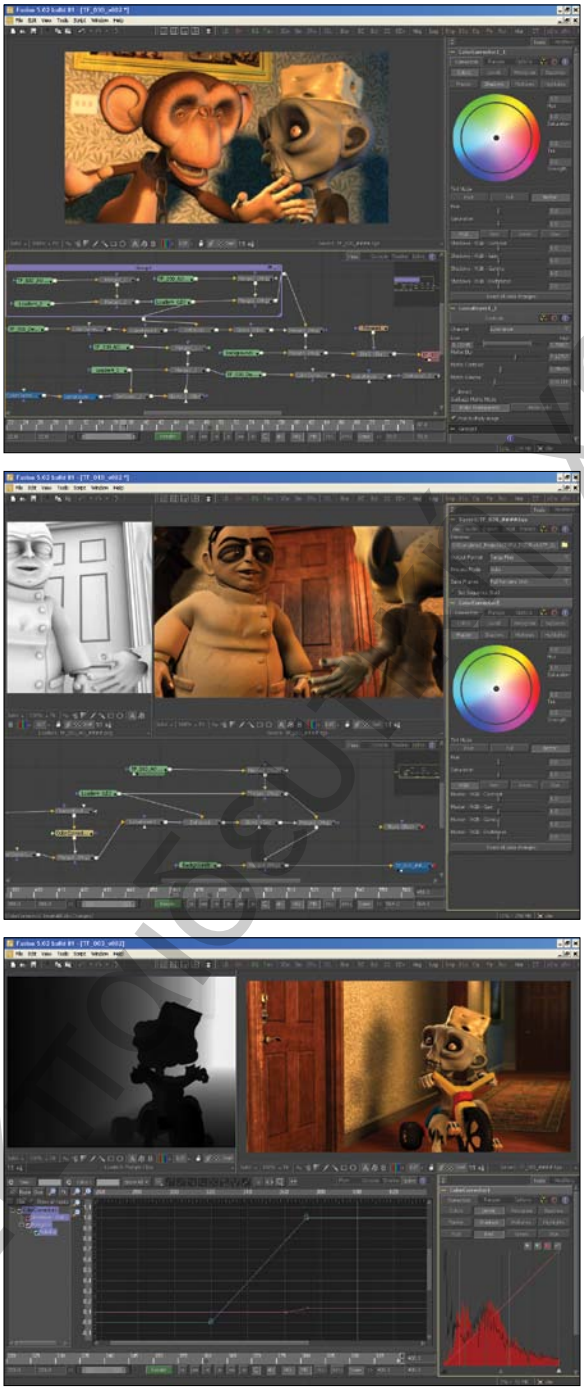
Stage 3: Post-production

Post-production is the part of the process that may take the longest due to the refinement of all of the aspects of the final product. Although this is the last step in the production of an animation, it is key to a project's success. Images get enhanced by compositing, the sound track and dialogue get tighter, and the edit gets tweaked for the most effective presentation of story and pacing. This is the point of the project that can make or break it and should not be taken lightly. It is what the production team loses the most sleep over.

Compositing

Compositors start work towards the end of the production process, combining the rendered elements created by the render artists into a finished sequence.

Most professional compositors have an understanding of color theory and an artistic eye. This allows them to enhance the lighting and color of the shots, maintaining the established look from the director and visual design artists, but refining it with a final layer of polish. **Figure 2.22** shows shots from *Zombie Dearest* receiving this final layer of polish by applying color correction, using an ambient occlusion pass to help add realism to the shading of an object, and taking advantage of depth passes to add depth of field and environmental effects.



[Figure 2.22] Compositors add the final tertiary details to each shot, including things like color correction (top), using an ambient occlusion pass to help add realism to the shading of an object (middle), and taking advantage of depth passes to add things like depth of field and environmental effects (bottom).

Industry Insight Lee Stringer

Lee Stringer, Emmy Award–winning visual effects supervisor, shares some insight on the role of a compositor:

> These days, compositing includes many new tasks. Gone are the days of simply combining several elements to create the final image. Yes, that's still a major part, with live action green-screen footage being combined with computer generated locations and effects elements. More and more compositing is used to actually light and texture many of those CG images.
>
> Having a good eye for color is key. Color correction is a major part of the compositor's job and although it's always ideal to have the textures of all the CG elements adjusted to the environment they will be rendered in, this can be tweaked much quicker in a comp.
>
> A great example of how compositing can be used within an all-animated film or TV series is the workflow used on *Star Wars: The Clone Wars*. In Lucasfilm's pipeline, just about all the lighting is actually done in the compositing stage. When a scene is lit, no real consideration is given to the color of the light and little to its intensity. (Only the position and direction of the light are adjusted.)
>
> Instead, the scene is generally lit with three lights giving the key (example: sun), fill (opposite of the key), and bounce (under fill), and then rendered with each light set to red, green, and blue respectively. Once in the comp, these three lights can be quickly separated, and each light can be colored with its brightness adjusted almost in real time. Additional passes provide rim (edge) lighting in a similar way along with environmental lights. Not only can the lighting be adjusted and refined far quicker, but one render pass can provide three separate light passes. It's a very efficient workflow but requires much more attention in this stage of the pipeline. This same technique can also be used with live-action productions and was used on the new *Battlestar Galactica* series.
>
> Advances in software are opening even more control for the compositing stage of production with the new use of normal maps generated at render time (this shows us the direction each pixel is facing). It's even possible to add new lighting in the comp phase. Also, mattes can be generated to isolate just about any component, enabling the compositor to adjust all the properties from color to specular highlights or reflection.

By far the biggest change in the compositing phase for modelers these days is the ability of compositing programs like the Foundry's Nuke to load 3D objects into a comp. With an accurate camera track also loaded, the compositor can not only move items around in a 3D space (very handy for stereoscopic projects), but also project new textures or matte paintings onto that geometry. Generally, these 3D objects are of lower detail than the ones used earlier in the pipeline. This technique is being used to great effect at Energia Productions on *Iron Sky* where landscapes that would require extensive modeling and texture painting can be built fairly quickly and then painted on, adding detail, once in the shot.

With these advances in technology and the changes in production pipelines, it's now more important than ever for a compositor to have open lines of communication with the rest of the team. It's also the best time for someone interested in creating the final look of a shot to get into compositing.

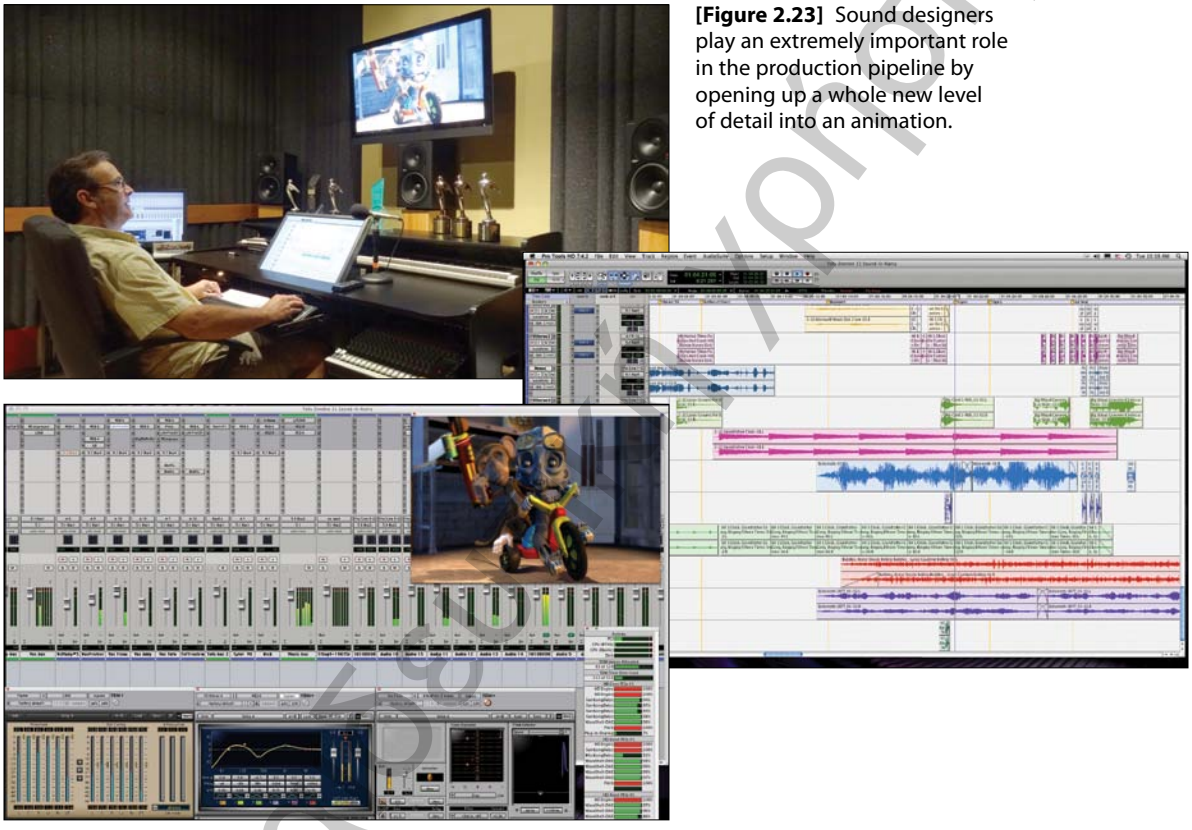
Audio

In most cases *audio engineers* work simultaneously with the rest of the crew by starting to develop the music and sound effects as early as the animatic has been locked. These masters of sound open up a whole new level of awesome into an animation.

I'll explain the importance of good audio in an animation by pointing out that sound contributes 50 percent of what makes an animation a success or a disaster. I've been fortunate to work with talented sound designers throughout my career, and one such audio guru, K. C. Ladnier, owner and lead sound designer of Sound "O" Rama, has helped several of the projects I've written and directed become award-winning animations.

Industry Insight K. C. Ladnier

K. C. Ladnier is shown in **Figure 2.23** working on the audio for the *Zombie Dearest* short.



[Figure 2.23] Sound designers play an extremely important role in the production pipeline by opening up a whole new level of detail into an animation.

Read K. C.'s thoughts about how sound relates to an animation production and to the work of a digital modeler:

> I was first exposed to sound design for animation at Walt Disney Studios in 1982.
>
> Early models (characters) were simple and hand drawn—interesting but just pictures. If the character artists were fortunate, they had access to sound recording and editing equipment. If the character artists were very fortunate

(or good), they were able to add music. It was not uncommon to see a character artist lurking around with a sound recorder, searching for something to record that would transform the character into something more than just pictures. Sadly, over time, I have seen less and less of the character artist's involvement with sound.

The ear is a terrible thing to waste.

The ear is connected to the brain from which the mind receives information that it processes and uses to make decisions about the world we live in. For eons humans have relied on this ability as a survival tool. Smart people tell me that the brain has many amazing abilities, including one where it combines multiple sound reflections like those that occur inside a cave or racquetball court. Sounds that arrive at the ear and are within a certain time interval of each other are combined into a single sound. The single sound is sent to the mind. This gives humans much greater ability to determine the location of predators or prey and to communicate in an ambient environment. The result is a much greater chance of survival.

The brain is constantly processing sound arrivals and sending information to the mind, even when you are asleep. You are completely unaware of this yet it happens in every theater that has adequate atmosphere.

My job as sound designer is to provide the brain with sound that makes sense and adds to the telling of the story. I use sound and music to lead your mind and your emotions. This increases the likelihood that you will experience suspended disbelief in the theater.

Let's say a modeler makes a character that wears a swinging chain and has flat feet that slap onto a marble floor. If I show you this animated character with good sound design, the information sent from your brain to your mind will be completely different from one presented with bad sound design.

With good sound design, the brain sees with your eyes that the chain is made of links and has motion. With your ears it knows the chain emits a metallic rattling sound. This information is passed on to the mind, and you think: check, one metal chain.

Everything makes sense.

Then the brain reports that the flapping sound and the image of feet hitting the marble floor appear to go together. The mind takes in all this information and might decide that this character is a duck. Oh! There is a quack sound, yes, must be a duck.

Without good sound design, the mind is not sure about anything. The chain emits no sound. Is it made of cotton? Is it in a vacuum? *I don't know!* And that is the information that gets passed along from the brain to the mind, lowering the likelihood that you will experience suspended disbelief in the theater.

This is the dynamic that flows through great productions. It flows between the group of artists that makes the pictures and the group of artists that makes them live. The more thought and imagination that is put into a digital model when it is created, the more life can be given to it using sound design and music.

Final Edit and Delivery

With all of the elements in the edit, the director, working with the editor, fine tunes the movie before putting it to bed. **Figure 2.24** shows editor Joseph Schneider putting the final edit together for an animated clip. Although much of the refinement in the edit of an animated piece happens during the creation of the animatic in the pre-production stage, the director and editor may still need to tweak the film for many reasons. Sometimes shots that seemed necessary in the animatic may have to be cut out for reasons of either pacing or budget. Once all of these issues have been resolved (or maybe time just runs out—it happens) and the sound track is finalized and added to the edit, the film is finally complete and ready for mass consumption.

[Figure 2.24] Editors work closely with the director to put final tweaks on the project. They are also the final artists to work on a movie, giving it a final polish.

Evolution of Production Pipelines

Although the basic structure of production pipelines is usually the same, the pipelines are different depending on a studio's idea of what the most efficient setup will be to produce the type of work it sets out to deliver. In most cases, pipelines evolve over multiple productions based on experience gained from past productions, keeping the components that work and removing or replacing the elements that were the weakest. Over time, a studio's production pipeline becomes solid and efficient for that particular studio's way of working.

Every once in a while, pipelines take a massive leap in evolution that can forever change how a studio or the industry as a whole approaches a production, introducing new stages and/or positions and departments.

Two perfect examples of this type of pipeline evolution are the virtual art department and the stereo department.

Virtual Art Department (VAD)

The *virtual art department* (also sometimes called *virtual art direction)* is now a fully recognized area under the jurisdiction of the ADG (Art Directors Guild) and is widely accepted as a major new area of the craft of filmmaking and television production.

Conceived by Rob Powers and his team of digital artists for James Cameron's *Avatar*, the virtual art department enables a unique, real-time, interactive system that combines different technologies for virtual production. This efficient workflow gives a director a real-time workspace, allowing for the flexibility to make important changes on the fly—something every director dreams of in movies that require heavy use of CG elements.

As live characters on the motion-capture stage are being shot, a director can see CG representations of characters and environments in real time and in-camera, and they can be used for composition and blocking. **Figures 2.25** and **2.26** show two examples of this setup in action.

[Figure 2.25] The virtual camera, virtual environment, and performance-captured actors all combine to provide the immersive virtual production experience.

[Figure 2.26] The virtual art department process allows for virtual location scouts and shot blocking very early in the modeling and design phase of production.

Artists working in the virtual art department are responsible for creating low-poly environments, props, and occasionally characters that serve as a foundation for final assets. These representations can vary widely, ranging from gray-shaded primitives for rough layout to modeled environments complete with detailed textures and matte paintings.

This new time-saving system is so efficient that it's being adopted by many studios working on productions such as *The Adventures of Tintin*, *A Christmas Carol*, *Mars Needs Moms*, *Jack the Giant Killer*, and many more.

Industry Insight Rob Powers

Rob Powers, virtual art department supervisor and virtual art director in the ADG, shares his firsthand experience of working in the virtual art department on *Avatar*:

> With the industry's first virtual art department on James Cameron's *Avatar*, I was in a position of problem solving in areas that had never been previously attempted. The bleeding edge requires quite a bit of "out of the box" thinking

and a willingness to approach problems with an open mind. The VAD is essentially a very fluid and flexible hub where many departments on the product can collaborate in a real-time "sandbox" to achieve the most compelling final result in the completed film, television show, or video game. It allows everyone to work out all types of potential problems long before they become critical, and the VAD workflow can often change a production for the better through this collaborative discovery process.

The impact of the VAD workflow on modelers and the area of asset creation in general is profound. To facilitate the required flexibility and interactivity required by the virtual production process, VAD modelers must think of many different challenges that might face a director on set and build in to the assets as many options as possible. For example, where previously a pre-vis workflow may have just modeled a tree, the VAD modeler would break a hero tree down to its most basic components and design a hierarchy to allow maximum flexibility on the set. The tree trunk, branches, roots, and leaves would all be carefully considered and flexible enough to give the director the creative freedom on set to actually redesign the tree for a shot.

All of this would also have to be done within the constraints of a real-time display engine so it requires a fairly high level of creativity to maintain the integrity of the production design provided by the art department while keeping polygonal counts and overall data optimized. A modeler must also deliver "clean" assets consisting of tri or quad polygons only. Delivering an asset with n-gons (polygons with more than four sides) can often create shading errors and causes extra overhead for the render engine.

At its core, the VAD process applies a real-world director's camera perspective to all phases of design, development, and modeling. This simple but important new approach has a huge impact on the final resulting assets. Assets created with the VAD process are more specifically geared toward the director's intent and are more "camera-ready" than they would have been with traditional approaches. Using asset creation software with a strong, integrated render engine and an included texture baking workflow, like that offered in NewTek's LightWave software, allows the artist to "bake" in beautiful lighting and textures, which go a long way toward increasing the visual impact of the virtual assets.

Another very unique aspect of the VAD modeling process is the art of manufacturing 180 degrees of a setting not represented fully in a concept painting. Of course, the key locations will often provide many angles, but more often than not, there are a significant number of sets or locations that have only a single-angled concept painting as the guide. Working with a virtual art director, the VAD modeler must invoke the look and feel or "spirit" of the concept art, but often actually creates many new assets that are not already designed. This can often prove to be quite a challenge, but also offers a very high level of creative freedom for those modelers who have a knack for design. The final result transforms a single-angle concept painting into a full 360 degree virtual environment or set that is ready for the director to shoot on.

The virtual art department process and virtual production workflows are really like a merger of real-time gaming technology with film and television production. This new, innovative resulting workflow enhances overall team collaboration, facilitating the director-centric production process that has guided film and television production for over a century.

Stereo Department

Stereoscopic 3D is a technique used in production that creates or enhances the illusion of depth in a 2D image. It's important to understand that it is an illusion—a trick of the eyes. Two images of the same subject, each from a different position, are used, which when wearing special glasses, trick the brain into merging these into one.

Stereo artists convert 2D films into blockbuster 3D experiences, as well as 3D assets into stereoscopic 3D. Although both methods achieve (mostly) the same result, the processes behind creating these images are very different.

In CG films like *Up*, *How to Train Your Dragon*, and *Battle for Terra*, the characters and situations all exist in a digital 3D space. This 3D space is calculated in Z-depth (the third dimension toward and away from you when looking down at a flat X and Y axis) and can be represented in a second eye by either using the Z-depth information to convert the film or by adding a second camera and rendering out that second eye. **Figure 2.27** shows a scene from *Zombie Dearest* being converted to stereo 3D.

[Figure 2.27] This shot uses a single-camera stereo setup using a grid-shaped null to measure convergence (the focal point of the shot).

In 2D to 3D conversions of live-action films that were not shot with two cameras, the Z-depth information has to be artificially created by an army of rotoscoping (tracing over live-action film movement frame by frame), depth, and compositing artists.

Industry Insight David Maldonado

David Maldonado, depth artist at Stereo D, has had the benefit of working in both stereoscopic methods and shares some of his experience:

> While working as a depth artist on the 3D versions of *Thor*, *Captain America*, and the fifteenth anniversary version of *Titanic*, I had to approach Stereo D's proprietary procedure of 2D to 3D conversion with a certain amount of delicacy. I had to be mindful of this new way of presenting film, respecting both the creators of the films' visions as well as the eyes of the potential audience. Although stereoscopic viewing has been around for a long time, this new method of presenting it hasn't and is still in a stage where it needs to prove its worth to the general populous.
>
> We have to make the stereoscopic viewing experience not only comfortable to the eyes, but also an enhancement to the movie-going experience. New methods of presentation are developed every day, and it helps when those who are developing these methods have a legion of cooperative artists behind them to help make these experiences possible.
>
> There are specific challenges that the roto artists, depth artists, edge clean-up artists, and stereoscopic compositing artists face every day, and no one department is more important than another. We all have to work as a cohesive unit to make sure that the film gets delivered on time, and that can only work if we remain in constant, respectful communication.
>
> When I worked on the 3D conversion of the animated feature *Battle for Terra*, I was part of a team that was going into each shot's scene and adding an additional camera that would be the second "eye." Setting this second camera in a place that truly enhanced the original vision of the shot while being mindful of how much or how little things were popping out of the screen plane was an exciting challenge and important to the success of the film. Each shot was populated by several digital models with baked-in animations, preset lighting, and visual effects. Knowing the proper naming conventions and paying attention to studio protocol was just as important as setting up each shot, and an attribute you learn to value in your coworkers.
>
> In the end, it doesn't matter which method of stereoscopic is being used to present the material. The audience doesn't care *how* it got up there, the audience just wants to see something amazing, and it is up to the stereo artists to make that experience possible.

You should now have a better understanding of the production pipeline and where a digital modeler fits into the big picture. Although you may only have interest in modeling, I have found that the more I learn about the other aspects of production, the more efficient my models become. Another benefit that most artists don't think about is the development of their professional reputation. The more aware you are of your place in production and how you interact with everyone involved, the better chance you have of doing a good job and getting more work based on positive word of mouth. As huge as this industry may seem to you now, in reality it is very small, and news travels fast within it. Keep that in mind with every project you lend your talents to.