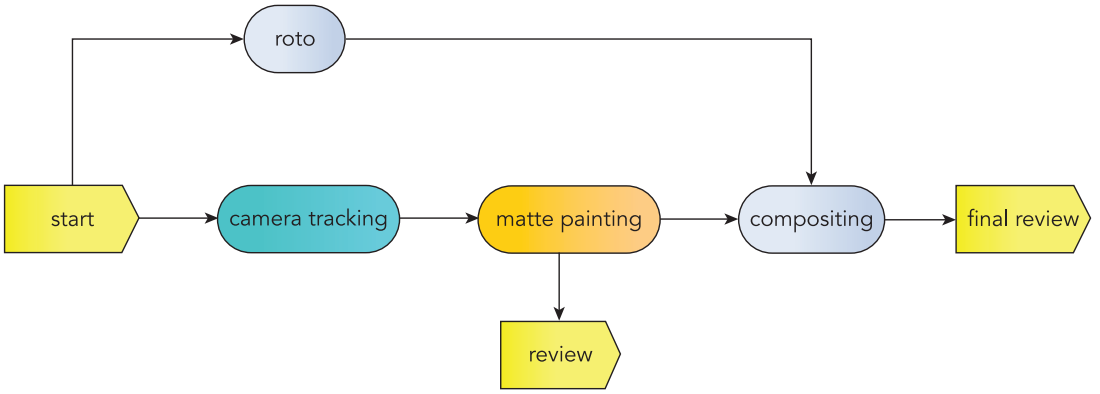


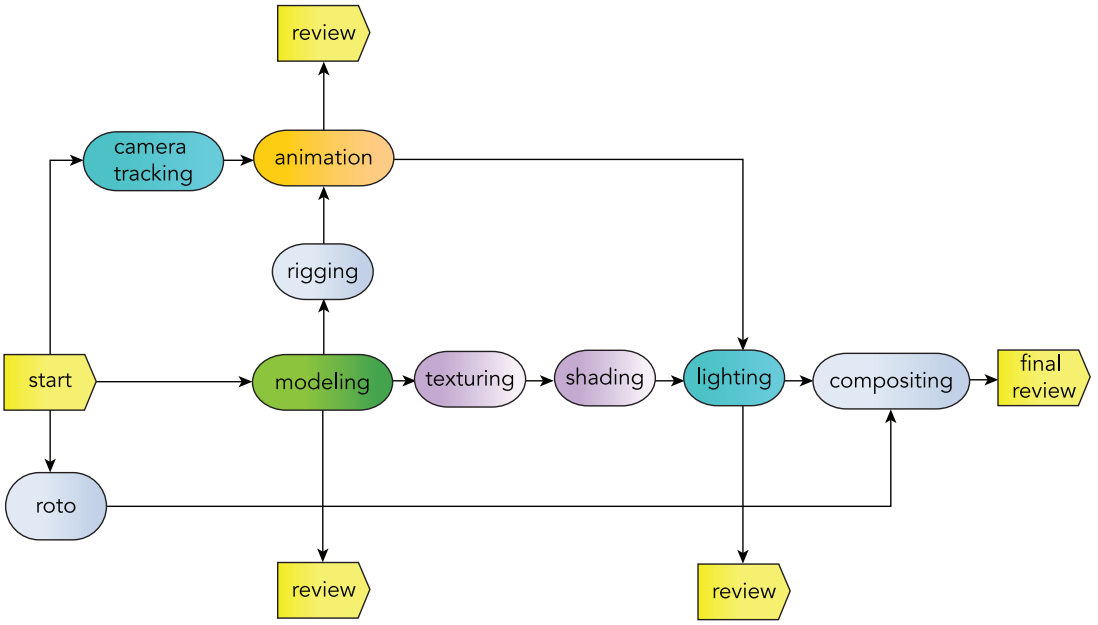

Shot 2: flow chart.

a matchmove artist for the camera tracking; a matte painter for modifying the background; a roto artist; and a compositor to extract the tiling plates and put everything together. Roto work started immediately while the matchmove artist was tracking the shot. Once the track was ready, the matte painter started working on the environment. The compositor joined in as well, updating the comp as the roto and matte painting work was progressing. Camera tracking took a day to complete, and the environment matte painting took about five days. Such a matte painting also requires feedback from the filmmakers—it is a prominent visual element in the shot—so we sent a single style frame for review and feedback even before the roto and comp were completed. It took about a week and a half of compositing to extract all the tiles, lay them down to create the crowd, work on integration and fine-tune the small details. With four artists and some of the work overlapping, the shot took a little less than two weeks to complete.

## *Shot 3: Piranha Attack*

In this shot, two people get entangled in a fishing net underwater and are struggling to get free while being attacked by Piranhas. The actors were shot in a diving pool by an underwater camera operator. Green screen was never an option for this underwater shot—first, because it would be almost impossible to get a good extraction in a murky underwater environment, and second, because it would ruin the lighting (which was carefully set up to create an illusion of a natural river, and to hide the pool walls). Subsequently, extensive roto was required not only to separate the actors, but also the fishing net around them (to enable placing fish behind the net, in front of the actors and behind them). However, the main difference between this shot and the preceding two examples is the fact that it involves animated CG animals. This puts it squarely in an altogether higher category of complexity—which obviously reflects on both schedule and cost.

Concept art was not needed here, because the Red-Bellied Piranha is a real animal. But proper reference material was crucial—and we gathered still images and videos by shooting real Piranhas at the NY Aquarium and collecting additional reference from the web. This reference was used to study the look




Shot 3: flow chart.

and movement of the fish, and served a vital role in the process of creating and animating realistic Piranhas. The CG work required a modeler, a rigger, a texture artist, a lighting TD, and, of course, an animator. It also required a matchmove artist (since the camera was hand held), two roto artists, and a compositor. In all, nine artists worked on the shot at one point or another.

Some of the toughest challenges were replicating the erratic movements of Piranhas in feeding frenzy and integrating the fish into the murky backlit underwater environment. Overall, the work took several months to complete, from gathering reference material through preliminary animation tests to the final comp. But as I will explain, much of that time was spent on developing and testing the CG asset for the entire sequence—which meant that subsequent similar shots took considerably less time to complete.

## *Asset Work vs. Shot Work*

When dealing with CG elements we can split the work into two categories: **asset work** and **shot-specific** work. An asset is usually a CG model or character that will feature in several shots or sequences. Therefore, the work spent on creating the asset does not need to be repeated for each shot. Asset work includes modeling, texturing, shading, and rigging. Shot-specific work includes tracking, animation, simulation, lighting, and compositing—tasks that depend on factors that differ from one shot to the other. Theoretically, the asset work can start even before the film has been shot. The designs and concept art serve as reference for the modeling work, after which the process moves into UV mapping,

texturing, shading, rigging, and simulation setups like cloth, hair, and fur. While some work can happen simultaneously, the process is fairly linear—for example, the model should be finalized before moving on to texturing, as changes in the model often require re-doing the UV mapping. On the other hand, shot specific work must be performed individually for each shot, even when re-using the same asset. The camera movement and lighting vary between shots, and the animation is obviously shot-specific.

## *Shot 4: Tsunami Mayhem*

This shot is a wide overhead view of several city blocks getting hit by a tsunami wave. Hundreds of people frantically run away as the wave sweeps away cars, trees, and various objects; large glass windows explode and pieces of buildings fall into the water in big splashes. This is an example of a typical large-scale visual effects tour de force. Although we are looking at a massive amount of work here—from modeling and rigging to dynamic simulations of water and destruction—shots like this are quite common in most action/disaster/superhero movies, provided of course the budget can support the extensive work of a large VFX team. In this case I am not using an actual shot that we've worked on at Brainstorm. The

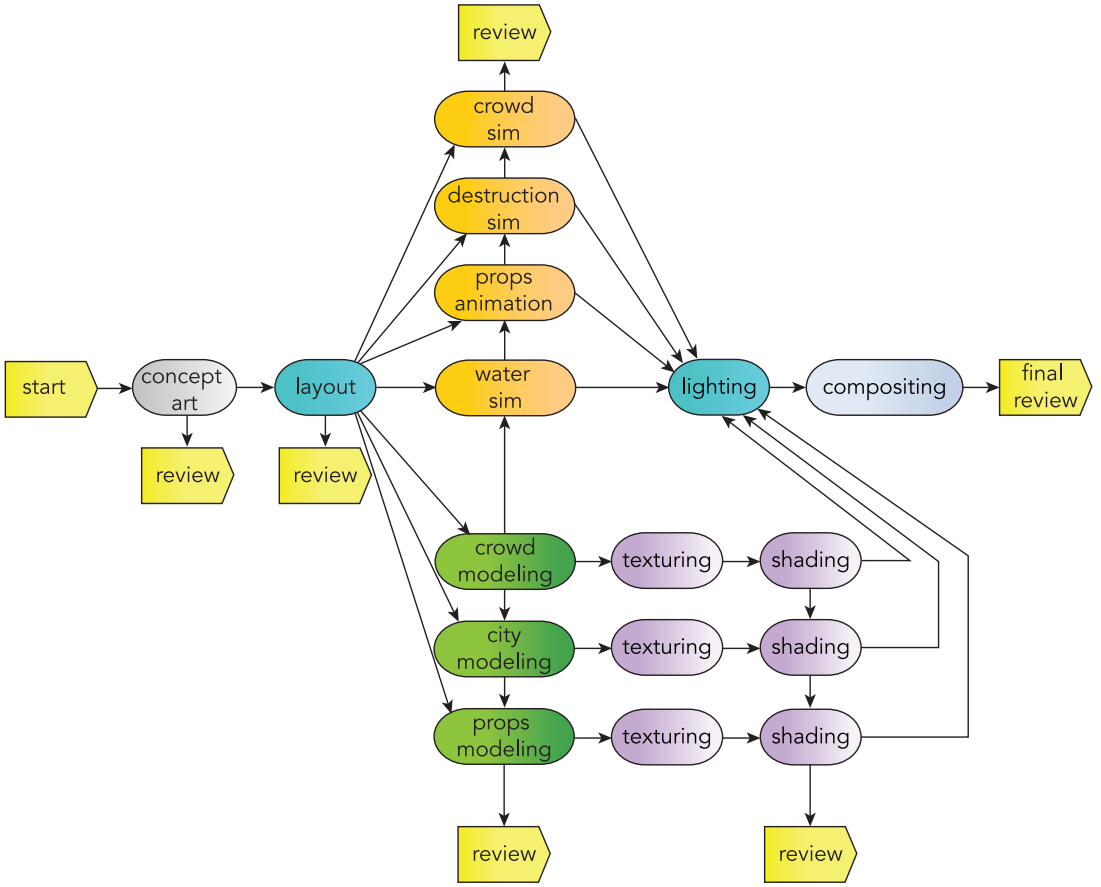
Although not quite the tsunami scenario described here, this shot from *San Andreas* represents a similar combination of massive water and destruction simulations, as well as all the related tasks like modeling, texturing, lighting, and compositing.

*San Andreas* © Village Roadshow Pictures, New Line Cinema, RatPac-Dune Entertainment, FPC, Warner Bros.

reason is simple: shots like this are barely within the capabilities of small or mid-sized companies, and are usually handled by large VFX facilities that have the necessary human and tech resources. I am not saying it's impossible for a small VFX team to handle such a shot, but the long time it will take to complete with limited resources makes it quite impractical within the parameters of a typical production schedule.

For this scenario, I am assuming that the director wants the entire city to be CG in order to be able to freely adjust the camera move (as opposed, say, to a helicopter shot of a real city, where the camera move is baked in). This requires building from scratch a substantial chunk of a city—a massive model when you think of all the detail that needs to go into it, the numerous additional vehicles and other props, and of course the various human models for the crowd. All these assets need to be designed, modeled, textured, and shaded, and any asset that will be animated needs to be rigged. The city model (or a low-poly version of it) can serve as a base for the layout artist to design the camera move, a critical step in a fully CG shot. The camera animation will dictate a lot of the action, so once the camera move is approved, simulation and animation work can start. Because of the complexity and scale of the dynamic simulations, several teams will be working in tandem, one on the water, one on the crowd, another one on destruction and debris. The tricky part is getting all these to work together, since there's obviously a strong dependency between the elements and the way that various events unfold. The water will most likely be the leading factor here, driving the destruction and the actions of the simulated crowd. The tweaking and refinement of the simulations is a slow and time-consuming process, and so is the final rendering of such a heavy scene. It's hard to predict the exact number of artists that will be contributing to such a shot at one point or another, but it would not be an exaggeration to estimate around ten or fifteen people, or even more. Successful completion of such a shot also requires adequate hardware like fast workstations and a powerful render farm, as well as tech support and system administrators to make sure that simulations and rendering all run smoothly.

Work on a shot like this, from concepts to final version, can stretch over a substantial period of time. During that time the filmmakers need to review the progress at different stages, from concepts and layout to specific models, look development, animation, and comp. Budget and schedule must be carefully (and realistically) calculated. Any attempt to squeeze such a shot into an unrealistic budget and timeframe is a sure recipe for failure. Moviegoers nowadays are accustomed to seeing these types of massive VFX shots, and, consequently, are much less lenient toward half-baked ones. Careful planning and a consistent and timely feedback loop are a must. The filmmakers need to be tuned into the process from start to finish—asking for major revisions or changing concept mid-way through or toward the end should be avoided. Reviewing and approving the work in progress at different steps through the process ensure that the final results are completed in time and on budget.




Shot 4: flow chart.