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HOW DOES A FILMMAKER BLOW US\$1.1 MILLION ON LESS THAN ONE MINUTE OF BIG-SCREEN ENTERTAINMENT? Digital Domain's budget for a 40-second shot on the deck of the *Titanic* translates to \$27,500 per second, making it the most expensive cinematic moment to date. (The average CG f/x shot lasts only five seconds, at a cost of \$25,000 per second.) The scene begins with actor Leonardo "King of the World!" DiCaprio whooping it up on the prow and pulls back into a slow reveal of the entire ship, with a nonexistent camera tracking freely in digital space. Hundreds of motion-captured virtual actors walk the decks, faux water splashes up against the ship's bow, simulated smoke billows from stacks, an artificial afternoon sun casts long shadows. Together, these elements conspire to make the shot an algorithmic achievement that, unlike the ship, may prove unsinkable. — *Paula Parisi*

LIVE ACTION. Both a scale model of the ship and actors Leonardo DiCaprio and Danny Nucci are photographed against a greenscreen. As the camera swoops back from the pair into a pan of the ship, their images are swapped with digital re-creations. Broken out separately, the actors' fees would be the cheapest line items on the chart—about \$4,000 for DiCaprio and \$500 for Nucci. **COST: \$150,000**

SYNTHESPIANS. The decks are populated with 515 CG humans to infuse the shot with motion and life. Body doubles (mostly DD staffers) were recruited for motion-capture sessions. They were rigged with recording markers, and their actions—strolling, bending, chasing a ball—were picked up via infrared-based cameras. The data was then used to animate CG figures. Rendering shadows, which had to remain consistent with those of the ship, became an additional hurdle **COST: \$300,000**

SCALE MODEL. A 44-foot, 1/20th-scale *Titanic* model, built of wood, plastic, steel, and brass, required 50 craftspeople to toil for four months and cost close to \$1 million. Based on original blueprints from *Titanic* builder Harland & Wolff and built with 1,000 portholes and 100,000 rivets, the model never once touched water. Since this prop was used in scenes throughout the film, the figure below represents the cost of its use in this one shot. **COST: \$50,000**

FINISHING TOUCHES. Digital birds, smoke, flags, Marconi wires, and wind-rippled canvas lifeboat covers were plugged in. **COST: \$100,000**

OCEAN OF BITS. DD codesmiths enhanced an off-the-shelf water-simulation program so the ocean would respond to the ship and such environmental elements as light refraction, wave patterns, and wind speed. Collision-detection algorithms produced a loamy wake the length of the ship's hull. Real water was photographed for splashes on the bow and wake at the stern. **COST: \$250,000**

COMPOSITING. In the final step, compositors assembled the elements that make up the scene, including 400 to 500 layers of digital-effects imagery, which was then output to film. "We hit the limit with our software, which goes 300 layers deep," says compositing supervisor Carey Villegas. "So we had to write scripts to put it all together." Render time for water was tediously slow, averaging three hours per frame. The liquid landscape alone accounted for some 3,000 hours of CPU time. **COST: \$250,000**

TOTAL COST: \$1.1 MILLION TOTAL · LENGTH OF SHOT: 40 SECONDS, or 954 FRAMES

Source: Estimates derived from data provided by Digital Domain and other f/x houses.

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