ROLAND MANGOLD

Physical Scale-Models: Real 3D As-built Data You Can Touch

The tremendous need for reality capture foretells great potential opportunity for LiDAR and laser scanning. The vast amounts of data being collected by LiDAR, laser scanning, photogrammetry and the ability to process all this data into something useful is the key. I find the convergence of reality capture technologies with 3D printing and rapid-prototype technology to be particularly exciting.

The process, or cycle, of scanning a physical object, creating an accurate digital as-built and then coming full circle from physical object to digital 3D model and back again to creating a physical model is made possible by the proliferation of 3D printers and rapid-prototype technology.

Any type of infrastructure work is almost always preceded by some type of topographic survey, mapping, capturing reality and creating as-builts. We live in a three dimensional world and it is just a matter of time before it is captured digitally … LiDAR and photogrammetry are the best means to achieve this goal. The logical next step is to produce 3D physical models.

There are great benefits to creating 3D physical models of terrain, buildings and infrastructure … it's the great tactile experience of a real physical object that has yet to be undone by the digital revolution. Most people who see scale-models want to pick them up and touch them—to get the feeling of the terrain with their hands. The haptic experience—relating to an object through the sense of touch—is a powerful communication and education experience and can be used as an additional stimulus for communicating topography and terrain of a region or the characteristics of an object.

Three dimensional architectural and topographic models have been around for a long time … the finest historical examples of 3D physical models of terrain and infrastructure can be found at the Musee des Plans-Reliefs housed, appropriately, in the Army Museum at the Invalids tomb of Napoleon I in Paris, France (www.museedesplansreliefs.culture.fr/).

Built between 1668 and 1873, nearly 260 models, representing 150 fortified towns make up this collection. The initial objectives were strategic: it was to help policymakers, the king, the minister and the generals, to realize the real situation of border places and their environment, help them prepare military campaigns and to teach the art of fortification to the military.

The beauty of the models is they provide a visual and physical record of the terrain and facilities back in the day. These physical

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PUBLISHER Allen E. Cheves
publisher@spatialmedia.us

MANAGING EDITOR Roland Mangold
editor@lidarmag.com

GROUP EDITOR Marc S. Cheves, LS
marc.cheves@spatialmedia.us

CONTRIBUTING WRITERS
Stephen Clancy
Dr. Srini Dharmapuri
Jeff Fagerman
Lewis Graham
Bill Gutelius
Ted Knaak
Michael Olsen
Jarlath O'Neil-Dunne
Michael Raphael
John Russo
Karen Shuckman
Ken Smerz
Nick Palatiello
Paul Tice
James Wilder Young

The staff and contributing writers may be reached via the online message center at our website.

GRAPHIC DESIGN LTD Creative, LLC
WEBMASTER Joel Cheves
AUDIENCE DEVELOPMENT Edward Duff
MEDIA RELATIONS Richard Bremer

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snap shots in time are invaluable as many of these sites and buildings have been lost to natural disasters, destroyed by war, or ravaged by the passage of time. The Musee des Plans-Reliefs models are simply fascinating to me as a history, geography and architecture buff.

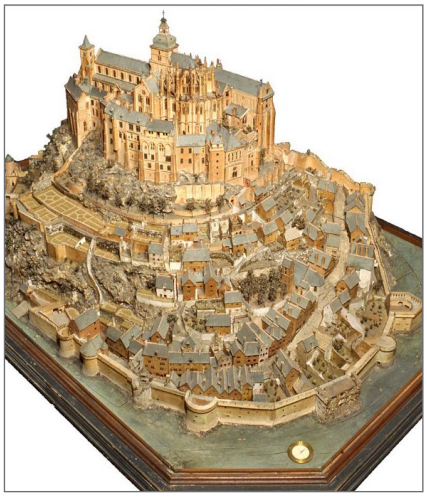
A Brief History

The tradition of building scale-models of geographic terrain and facilities dates to the 1520's when the Grand Duke of the Knights Templar commissioned a model of the city of Rhodes in preparation for the Turkish siege. In the 16th century, Italian engineers would present France's Charles IX with relief maps and scale-models at each step of building a fortress. The idea of building and construction documentation was born.

With the advent of more powerful weaponry, the fortified town became obsolete and the perceived value of scale models lapsed into obscurity. Since then, the building of scale models has become a fundamental planning, design and communication tool well ensconced in the architecture industry. However, other than architecture and the military, scale-model building has not been exploited by many of the other applications where similar or equal benefits can be realized. Physical scale modeling of geographic information has been rare, possibly missing the tradition of model building as in architecture where the cost of model building is a negligible quantity in relation to the overall project cost.

Applications

In the past, this has been a very expensive, time-consuming, arduous manual process for many applications such as engineering and GIS. However, with technologies such as laser scanning,



This model of the iconic Mont-Saint-Michel France was constructed in 1701.

LIDAR, close range photogrammetry, aerial and satellite imagery and 3D computer modeling capabilities, many of the data capture and creation issues have been addressed and rapid prototyping technology provides the solution to the laborious task of producing the physical scale models.

Increasingly, professionals in fields such as civil engineering, environment, mining, petroleum, pipelines, real estate development, transportation, and utilities are discovering the tremendous benefits of 3D physical models. From concept development through project completion—visualizing, learning, and communicating with physical models to explore concepts and communicate their vision to clients and stakeholders has become an invaluable tool.

Reality capture is an excellent application for 3D color printing since it is used to communicate information and help an organization make better decisions. Accurate communication of 3 D data is a critical part of the decision-making process. A 3D physical model of scanned data communicates much more information than a flat screen image or paper printout. The physical models allow people to communicate clearly and reach consensus on an idea more efficiently.

Rapid-prototyping models can be used by transportation and utility planning, watershed visualization, visualize how a land development will look on the landscape, mission planning for homeland security, battlefield simulation, base realignment and closure, oil and gas field visualization, just to name a few applications.

Conclusion

Recording, preserving and understanding historic and culturally important artifacts and environments is of paramount importance, and physical 3D models can be an essential element to engage and communicate with a range of users. 3D printing helps archaeologists and researchers to view, analyze, and even reproduce valuable archaeological artifacts and historic sites providing a more durable and tangible way to study and preserve artifacts.

The Knights Templar obviously did not have modern technology such as laser scanning and 3D printing. But they clearly recognized the value of terrain modeling, the Knights Templar were able to stave off the Turkish invasion and kept their stronghold in Rhodes. Thanks, in part, to their superior planning provided by the scale-model of their terrain and fortifications.

Until next time...Cheers!

Roland Mangold // editor@lidarmag.com