The cost and time associated with manually assembling and processing detailed image data are significant. While integrating three-dimensional (3D) data such as aerial laser scanning vastly improves the value and accuracy of the information product produced, this data is practically impossible to manually prepare and analyze. Only by using software to automate data handling and analysis is it feasible for organizations to tackle land-use modeling and mapping projects for large areas.

As part of an urban planning initiative from the European Union, the Department of Surveying and Geo Information (GEOinfo) of the State Government of Lower Austria generated sound-wave propagation models for traffic noise over an area of more than 20,000 km² (7,700 mi²) in Austria. To successfully perform this project, GEOinfo developed an application that detects and quantifies changes in forests, buildings, and bodies of water using aerial laser scanning and orthophotos and Trimble Inpho and eCognition® software. With measured accuracy ratings above 94 percent, the automated approach provides an information product that would be completely unviable and cost-prohibitive to create manually.

In case you were wondering, the State of Lower Austria is not in the southern part of the country. It forms roughly the northeastern quadrant of Austria, entirely surrounding the city-state of Vienna. The largest of the nine states in Austria, it is named Lower Austria because it is located down-stream on the Danube River, which flows through it.

Handling Airborne Geospatial Data
In the GEOinfo project, automation of photogrammetric processes and digital terrain model (DTM) generation was essential. Trimble Inpho, a leading photogrammetry and digital terrain modeling software suite, was used to manage and process GEOinfo’s aerial laser scanning data over large areas. The SCOP++ TopDM module was used to manage approximately 30,000 raw data flight strips from which 20,000 DTM and 20,000 digital surface model (DSM) data tiles were derived. Various other SCOP++ modules were applied to these data sets to perform tasks such as point cloud classification using powerful filtering strategies, shade calculation, slope calculation, profile tools and other terrain algebra methods. Available breaklines were used during these processes to increase the quality of the terrain modeling, especially in challenging topographic areas.

Michael Pregesbauer, Deputy Department Head at GEOinfo, was happy with the results: “The Inpho software allowed us to produce robust terrain models with virtually no manual interaction, which enabled us to produce and manage digital terrains in a cost-efficient, standardized and automated manner.” Without automation software like Trimble Inpho, processing laser scanning data of this sort is practically impossible. The output of these processes provides quality input data for the next workflow step: the production of value-added products.

Detecting and Quantifying Changes
GEOinfo utilized Trimble eCognition software to detect and quantify changes in forests, buildings, field and water areas from the DSMs, DTM and orthophotos. Within eCognition, a wide variety of source data can be imported, fused and segmented.
to create meaningful objects using prescribed conditions such as average elevation and normalized differenced vegetation index.

Rather than merely examining individual pixels, eCognition identifies objects and makes contextual inferences. Just like the human mind, it uses the color, shape, texture and size of objects as well as spatial relationships to achieve the same insights as an experienced analyst. These methodologies produce clear, intuitive results that facilitate simpler map construction.

This logic was applied to the data representing 20,000 km² of Lower Austria. To deal with this volume of data, a tiling and stitching technique was applied, creating 2000 x 2000 pixel tiles each representing 1 km x 1 km (0.6 mi x 0.6 mi) of territory. Within each tile, eCognition automatically classified elevated objects and distinguished buildings, trees, scrubs and sealed areas. Results were then stitched together and border effects removed to create the final information product for import into ArcGIS.

“The eCognition software allowed us to concurrently analyze both the digital imagery and terrain models and reliably extract the land-cover and land-use information we were seeking,” said Pregesbauer. “After testing commercially available software currently on the market, we discovered that only eCognition is able to efficiently accomplish this.”

Project Outcome
Analyzing an area of 20,000 km² requires massive amounts of data to be processed in a timely and cost-efficient manner. Replacing manual analysis routines with an automated, software-assisted approach makes it feasible to develop land-use models for very large areas without a large amount of resources. Where manual analysis of one building might cost 2–4 Euros (2.70–5.45 USD), the automated approach costs only 0.1–0.2 Euro (0.14–0.27 USD).

An accuracy assessment of the resulting shape files showed that built-up and forested areas were correctly classified for 94.3 percent and 96.1 percent of the area, respectively. With these high levels of accuracy achieved at such a low cost, the project was deemed to be highly successful and additional iterations are now planned for each of the next four years.