HEXAGON

Case Study

Bringing New Dimension and Accuracy to Swiss Mapping

The Swiss Federal Office of Topography (commonly referred to as 'swisstopo') is the national mapping agency of Switzerland, responsible for assembling and archiving the nation's geospatial data and information and overseeing cadastral surveying throughout the country. Swisstopo offers a wide variety of geospatial products to customers, including the national map series, elevation and landscape models, satellite images, and orthophotos. The portfolio provides products suitable for a broad range of purposes — from planning a hike or skiing trip through the beautiful Alps, to planning national transportation networks. Due to the exceptional quality and accuracy of swisstopo products, they have garnered a worldwide reputation of excellence.

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Perhaps part of swisstopo's ability to achieve and maintain such a sterling reputation stems from their relentless efforts to ensure the timeliness and accuracy of their offerings. For geospatial products to provide maximum benefit, they need to reflect the rapid change that occurs on the planet and leverage the latest advances in remote sensing and image processing technology. A few years ago, swisstopo resolved to shorten their multiple-year map production cycle and incorporate new offerings into their workflow. To initiate the improvement process, they identified the bottlenecks in their mapping methodology and proposed a solution to streamline their workflow.

Originally, the swisstopo production process consisted of multiple detached workflows. Some of the products in the portfolio, including major offerings, were being generated and maintained separately using disconnected systems and software applications. Personnel were assigned to each product, and since reassignment involved additional training and an initial learning curve, it was difficult to switch people to different products to accommodate deadlines and production needs.

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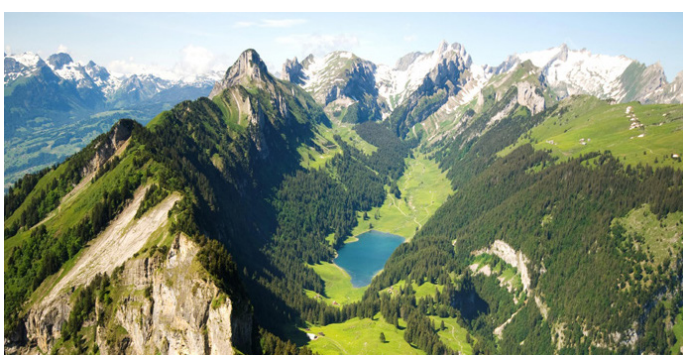
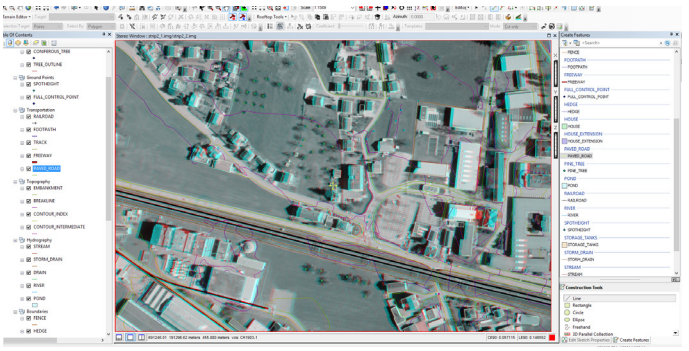
Integrating GIS and Photogrammetry

Ideally, swisstopo sought a single system interface for creating all the products in their portfolio, reducing the training requirement, and enabling the assignment of different products to existing employees as needed. Such a system needed to provide the benefits of a powerful GIS and a photogrammetry package. These capabilities would need to be merged seamlessly so that both utilities were available to operators and wouldn't require them to switch interfaces.



In addition to using disparate systems to generate products, swisstopo was also using different data sources consisting of a combination of analog, vector, and raster data. This data redundancy meant that updates had to be performed in several places, constituting a heavy demand on time and resources and increasing the potential for human error. In some cases, products were based on other products. For example, the basic digital landscape model produced by swisstopo was based on the 1:25,000 scale map in the national map series and couldn't be updated until that map was complete. In turn, every product dependent on that digital landscape model lagged even further behind. This caused multiple-year map production cycles for some products.

Swisstopo needed to consolidate the master data sources, enabling simultaneous updates of swisstopo's products. Furthermore, swisstopo was anticipating a change from the Leica RC30 airborne frame camera to the newer Leica ADS40 airborne digital sensor. They wanted to be able to take full advantage of the improvements in the raw data quality afforded by the hardware upgrade.



Collect features in X, Y, and Z coordinates using Stereo Analyst for ArcGIS.

Increased Accuracy with a New Product

Swisstopo also hoped to make improvements in the accuracy of their products, which was between three and eight meters at the time. Typically, feature data was initially captured with x-, y-, and z-coordinates, but the z-coordinate was discarded during subsequent data updates. To increase accuracy, swisstopo wanted to incorporate stereo photogrammetry into their workflow. Stereo feature collection is the most accurate way to collect and update feature data, enabling capture and retention of all three coordinates throughout the workflow. In addition to the increased positional accuracy, stereo collection makes it quicker and easier to distinguish the exact outline of features. For example, when collecting vector layers of roads from orthophotos, a bridge or overpass overlying a road can look very similar to an intersection. Additionally, certain

Launch a multiview window in Stereo Analyst to load an alternate stereo pair, orthorectified image, or calibrated image to use as an alternate collection source.

features, such as tall buildings, obscure their own footprints and those of surrounding features and require operators to perform some estimation during feature collection.

To remedy the shortcomings of the previous system, swisstopo decided to create a new infrastructure called TOPographic Geographic Information System (TOPGIS) to manage their workflow.

As swisstopo considered software applications to form the core of TOPGIS, the one overriding requirement was that there should be only one application used to create all products in the portfolio. The appropriate tool for such a large task would need to competently handle GIS management and photogrammetry, but there was not a product from a single vendor that comprehensively fused those competencies.

Swisstopo had already formed a relationship with Hexagon's Geospatial division and Esri® Schweiz AG, Esri's partner in Switzerland. Esri Schweiz AG and Hexagon partnered to offer ArcGIS® desktop and server products for collecting data in 2.5D (monoplotting), managing the GIS, and storing the geospatial data within a geodatabase and a suite of products from Hexagon's Geospatial Division for providing the stereo visualization and stereo feature collection capability.

Stereo Analyst® for ArcGIS, a component of the ERDAS Extensions for ArcGIS, enhances ArcGIS with stereo visualization capability that allows users to view stereo image pairs inside their ArcGIS environment and use ArcGIS' own editing tools to collect features, giving each vertex an x-, y-, and z-coordinate. After establishing the tools to use for the creation of the national landscape model, swisstopo shifted focus to terrain editing.

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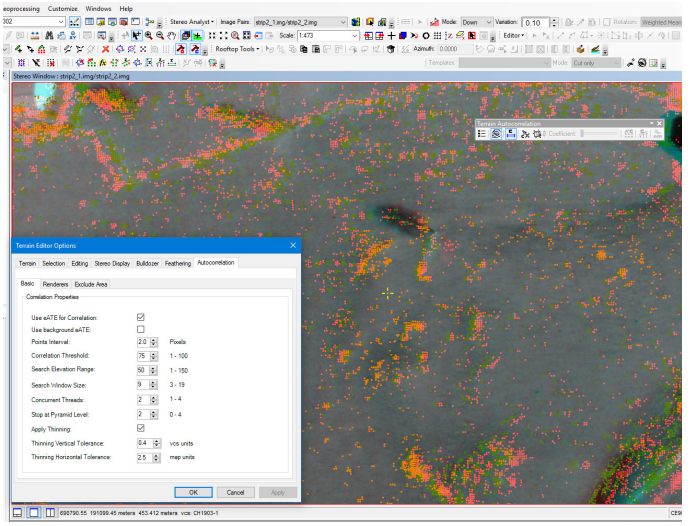
Swisstopo was familiar with IMAGINE Photogrammetry, Hexagon Geospatial division's suite of photogrammetric production tools, and its popular add-on, Terrain Editor. While swisstopo liked the functionality and accuracy of Terrain Editor, they remained determined to create a unified system that would allow a seamless workflow not hindered by boundaries between software applications. Hexagon launched ERDAS Terrain Editor for ArcGIS. An extension to Stereo Analyst, ERDAS Terrain Editor for ArcGIS enables the update of a DTM stored as a geodatabase terrain by displaying it as points and breaklines with triangle and contour display. As the terrain is edited, ERDAS Terrain Editor for ArcGIS dynamically updates contours in the stereo window to make it easier for the operator to visualize and interpret the terrain. Terrain Editor was also designed with a complete set of point, breakline, and area tools for modifying the terrain, including a tool for autocorrelating new points to participate in the terrain layer.

Within the new infrastructure, there would be two master sources of data from which the various swisstopo products would be derived. The Topographic Landscape Model (TLM) is a 3-dimensional GIS with an accuracy of one meter or better for the x-, y-, and z-coordinates. It serves as the data source for GIS dataset products and the national map series. The DTM-TLM is a digital terrain model created primarily from LiDAR data.

Both the TLM and the DTM-TLM are designed to be consistent with each other and are updated photogrammetrically using Stereo Analyst for ArcGIS, ERDAS Terrain editor for ArcGIS, and Leica ADS camera data. TOPGIS has also been designed so that fresh data from cooperating cities and cantons throughout Switzerland can be easily uploaded into it.

Leveraging the Power of Stereo

Swisstopo has seen significant improvements since the implementation of the solution. First of all, swisstopo was able to more than double its production speed from aerial photo flight to data delivery as a result of using the integrated interface for all the production tasks. This increase in speed enabled them to supply data products to customers faster than before.



Define an area, run autocorrelation, and merge the points into the existing terrain using ERDAS Terrain Editor for ArcGIS.

The time between the data collection and the completion of the map products is now only about nine months. Previously, it was approximately two years. Before the solution was implemented, the data would have been between one and three years old.

After implementing the Hexagon /Esri solution, the data is about a year old, at most.

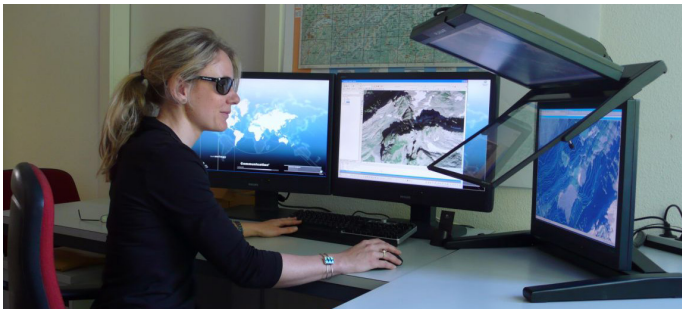
Swisstopo considers the most important advantage of the new system to be the increased level of detail they are now able to provide to customers. Before implementing Stereo Analyst for ArcGIS, the data was usually 1:25,000 map scale. Currently, it ranges between 1:5000 and 1:10000 map scale. By adding the ERDAS Extensions, swisstopo opened up the ability for its operators to collect, maintain, and use the 3D components of imagery which they had previously discarded due to their inability to use it effectively.

Stereo Analyst's stereo visualization capabilities enable operators to see the imagery just as they would see the scene in person — in 3 dimensions — so they can manually pick out the boundaries of features easily, quickly, and accurately. Viewing imagery in 3D also eliminates the estimation of feature boundaries when working with taller objects. When viewing buildings in orthophotos, tall objects will often appear to lean if not directly under the camera, blocking surrounding objects. In stereo, the operators will see these tall objects standing straight up, providing a clear view of everything below.

In addition to the enhanced visual acuity provided, Stereo Analyst offers simple, efficient tools such as the floating

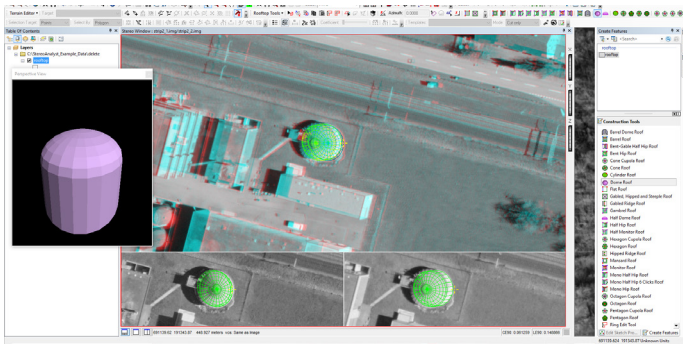
cursor, which shows the elevation of a point in the area of interest. This is effective when outlining features where the boundaries are still somewhat difficult to detect visually, such as buildings that are surrounded by parking pads or lots. It also makes it easier to differentiate between roads that intersect in the same plane, and roads that intersect by passing over each other, such as overpasses and bridges.

Stereo Analyst for ArcGIS and ERDAS Terrain Editor for ArcGIS also allow swisstopo to store more data than possible with their previous workflow, enabling them to provide feature layers that are more realistic and informative instead of flat. As points are collected in the stereo viewer, Stereo Analyst records the value along with the x and y values, so that object heights and the slopes of features and terrain can be calculated.



Hexagon's Geospatial division also created FeatureAssist for ArcGIS for the swisstopo TOPGIS project. FeatureAssist is another extension for Stereo Analyst for ArcGIS that enables the collection of roof structures in Esri's multipatch format. Using templates, FeatureAssist for ArcGIS can quickly collect these features, handling varying degrees of complexity. In addition to the templates, Feature Assist provides manual construction and editing tools for the creation or modification of any roof shape. Roofs can be extended to the ground or to an existing terrain. Because the multipatch format can store information such as a texture image, color, transparency, and lighting, this information can be used to create realistic-looking 3D models.

Swisstopo completed a project to collect and produce detailed 3D building models of the entire country, using the



Collect common roof shapes using multiple predefined templates in FeatureAssist for ArcGIS.

roof structures. The web-based digital model contains over 70 million 3D objects, expanding beyond the original goal of producing highly accurate models for various military and commercial applications.

Now that swisstopo has laid the new foundation for its production mapping process pairing Esri's ArcGIS and Hexagon's ERDAS Extensions for ArcGIS, they are working faster and more accurately than ever. With a single interface that allows them to perform all their tasks and a new ability to collect features in stereo, swisstopo is well-positioned to improve and expand their offerings to better meet the needs of their consumers and continue to enjoy their reputation of excellence for years to come.

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HEXAGON

Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications.

Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous — ensuring a scalable, sustainable future.

Hexagon's Geospatial division creates solutions that deliver a 5D smart digital reality with insight into what was, what is, what could be, what should be, and ultimately, what will be.

Hexagon (Nasdaq Stockholm: HEXA B) has approximately 20,000 employees in 50 countries and net sales of approximately 4.3bn USD. Learn more at hexagon.com and follow us @HexagonAB.

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