Geospatial Information Systems continue to revolutionize the way in which NATO operates

WHAT GEO BRINGS TO THE TABLE

Stay tuned to find out!

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ABOVE: (From left) TRIDENT JAVELIN 2017 Land Component Command in the JWC Bunker; ALES wargame 2018 at the JWC; preparing for a force coordination meeting, TRIDENT JAGUAR 2017. All photos by JWC PAO

THIS ARTICLE IS MEANT to add to the positive aspect of NATO's Transformation. In Joint Warfare Centre (JWC) Geo Cell, we see Transformation as an opportunity to define a bold ambition that goes beyond incremental change—it is an opportunity to rethink our business and operating models to facilitate new services and get much better value for money. Moreover, Transformation involves strategic decisions that affect where we will grow and how our organization will operate with a goal to improve performance. The JWC Geo Cell is taking advantage of improving technology to transform, and in doing so, we try to influence and improve the way other NATO geo teams work. Our work remains a critical enabling technology to the Member and Partner Nation militaries.

Geospatial Information has always been important to commanders, and an understanding of terrain is an essential military skill, with maps being the traditional means of delivering the common operational view.

NATO is always seeking to improve capabilities to maintain a credible deterrent and assure focused participation in warfare activities. A key driver for NATO is the vastly increased area of interest—what we call the "360-degree approach to security". Indeed, forces can be deployed into almost any part of the world without prior knowledge of the terrain. Geospatial Information Systems (GIS) are, therefore, essential in creating, editing, analyzing, querying, and displaying both hard and soft copy Geospatial Information to improve the commander's decision-making cycle.

In JWC, as in any organization, a compromise must be drawn between what is desirable and what is essential. This discrimination is made in terms of what is affordable. Value for money remains critical when providing Geospatial Information to the NATO Command Structure (NCS). The problem is further exacerbated when considering the resolution or fidelity of Geospatial Information that is required to support different levels of command. The relationship between area (geographical extent), scales, and user community can be seen in *Figure 1*. In theory, a strategic planning headquarters will be able to meet most of its needs using small-scale data. However, a tactical headquarters, such as a battle group commander, will need data at scales of 1:10k for target areas.

In an ideal world, NATO planners would have access to large scale maps of every part of the earth's surface. However, clearly, this is neither available nor affordable. To the other extreme, it would be very affordable, but clearly, not very helpful, to hold global coverage of only small-scale products. It is therefore important to find a good balance between these two extremes, measured based on affordability and acceptable risk. Keeping this balance is a key function of JWC's Geo team in Stavanger, Norway. As a result, during the last two years, five initiatives have been introduced, which have not only improved the quality and provision of Geospatial Information to staff, but which also have reduced costs significantly.

Use of OpenStreetMap (OSM) Data

In short, OSM *(see Figure 2)* is a free, editable map of the whole world that is created by the Geospatial Community of Interest. Critically, it is available with an open-content license, which means we can use it for any purpose. The data has matured sufficiently in some locations to rival "authoritative" datasets from governments and commercial entities. This is particularly the case in Western Europe and some parts of the United States. However, less densely populated places suffer from lack of data. For some locations the datasets are the only data source available. Some of the main benefits of OSM include:

- the data is available at no cost
- the source data can be downloaded and used to drive products
- it allows users to input data, which gives it a better and more valuable set of features than commercial or government maps
- the data is flexible and can easily be updated. In contrast, commercial and government maps tend to be updated on fixed cycles.

These are some of the main challenges of OSM:

- there is no systematic quality check performed on the data
- the precision and accuracy of OSM coverage varies, and there is no simple means of detecting this variation
- producing a focused set of data from OSM requires more technical skills.

From a JWC perspective, OSM provides worldwide coverage that allows us to "drill down" into specific areas outside of NATO sovereign territory, then copy and process the data to produce large-scale mapping in both hard and soft copy. Traditionally, this data would have to be procured commercially, which could prove expensive. The use of OSM is officially recognized by Allied Command Operations (ACO) and during data preparation for TRIDENT JUNCTURE 2018, a substantial amount of savings was realized in data acquisition and subsequent processing costs.

Increased vector mapping

Alongside OSM is the increased use of vector (information rich digital) mapping as opposed to traditional maps in raster (pixelated picture) formats. Both types of Geospatial Information are very useful, but there are important differences. The characteristics as depicted in *Figure 3* do not necessarily apply in all circumstances but serve as a general comparison. As you zoom into raster data, the pixel resolution becomes obvious. Eventually, the image looks like a series of blocks rather than a detailed map. Vector data is more like a series of lines drawn between points—the width remains the

GEOGRAPHICAL EXTENT	USER	MAP SCALE
1,000km × 1,000km	Strategic Planning	> 1:250k
400km × 400km	Divisional Planning	1:250k – 1:50k
150km × 150km	Brigade Planning	1:50 – 1:10k
50km × 50km	Battle Group Planning	< 1:10k

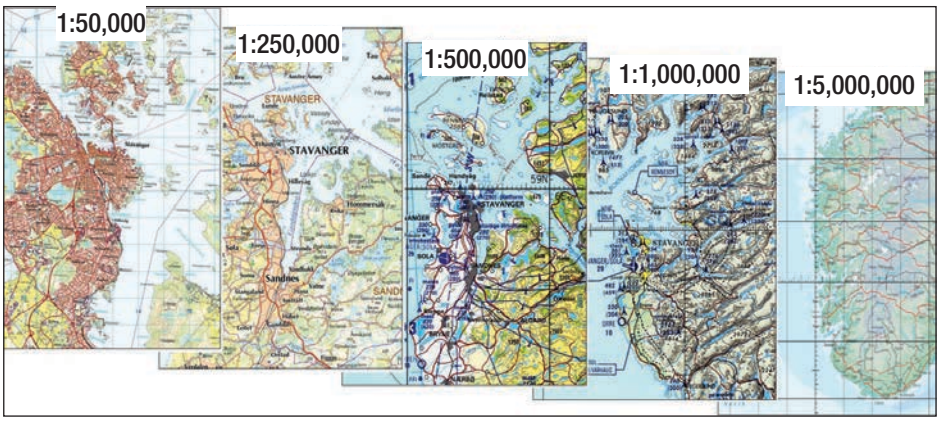

Figure 1: Differing map scales from Exercise TRIDENT JUNCTURE 2018.

same regardless of how close you zoom. The main advantage of vector in comparison to raster is better geographical accuracy and smaller file sizes. Viewing vector data is much quicker and less hardware intensive than the equivalent raster. The "so what" for the JWC is that we routinely use traditional raster mapping for small-scale products. These files are very cumbersome to manage and require not only large storage capacity but also the pre-processing of cache* data, which sometimes takes months to prepare. The JWC recently introduced the use of OSM vector data to replace old raster maps, some of which were over 40 years old. These new maps are produced in-house, and they are not only much more current but they also preclude the very expensive, externally contracted process for changing names and borders. Again, using TRIDENT JUNCTURE 2018 as an example, the use of vector mapping has saved a substantial amount in contracting costs alone. Concurrently, the JWC introduced an alternative to caching the data that could save equivalent to about six weeks of staff work per major exercise.

Future scenario development

The JWC geospatial team has had a five-year future scenario development plan endorsed by the International Military Staff at the NATO Headquarters. The scenario development work will encompass Europe, the Black Sea area, North/Central Africa and the Mediterranean, with the potential of further development into the North Atlantic and even a mega-city to support joint urban operations' training. The plan is to merge processed and raw Geospatial Information data from JWC's current three settings of *SKOLKAN*, *OCCASUS* and *FIKSO*.

The creation of this seamless and complete Geospatial Information repository by the JWC will provide NATO with a much more robust capability to support defence planning by ensuring the capture and presentation of Geospatial Information in a rigorous, coherent, standardized and comprehensive way.

Looking at the longer term, the repository will enable cost savings as a result of more efficiency. Resource savings will be realized by automating workflows and assuring critical continuity, increasing productivity by eliminating lengthy technical induction and familiarization periods. A systematic revision programme can also be established across the repository, taking advantage of the national Geospatial Information production programme schedules, and thereby reducing commercially sourced data dependency.

* A cache is a place to store something temporarily in a computing environment. In GIS, data is cached at certain scales to shorten data access time, reduce latency and improve input/output to improve application performance.

Figure 2: An OpenStreetMap from TRIDENT JUNCTURE 2018.

The lessons learned process

The JWC Geo Cell introduced a new lessons learned process for the TRIDENT JAGUAR 2018 exercise using internally generated geospatial statistics to validate the use of Geo web services. Surprisingly, during the planning and execution phase, the Multinational Joint Headquarters Ulm use of the Geo services exceeded

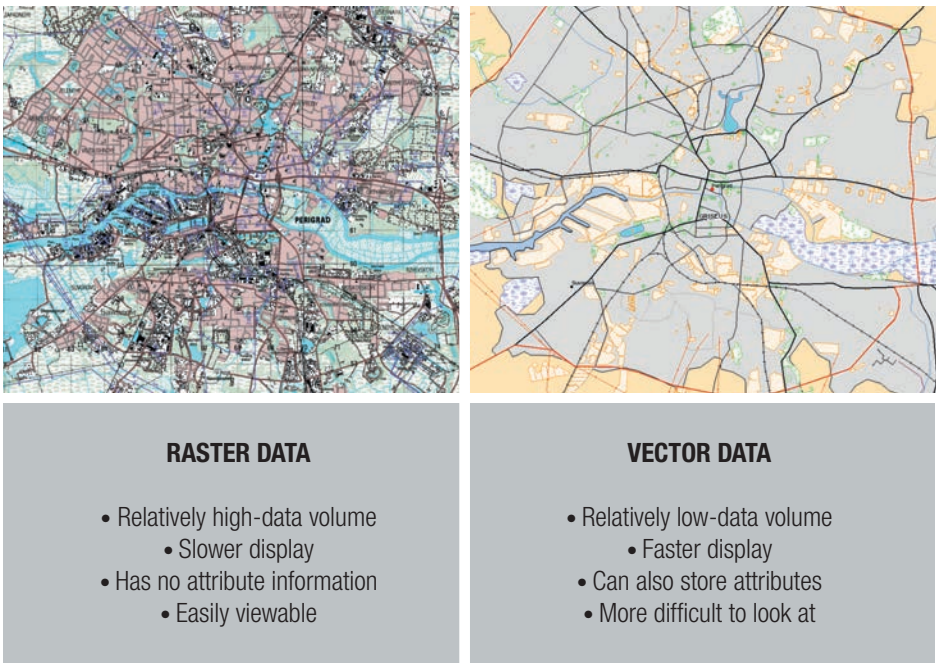

Figure 3: Raster and Vector Geospatial Information from TRIDENT JUNCTURE 2018.

JWC Geo team with the author in the middle, May 2018. Photo by JWC PAO

"The creation of a seamless and complete Geospatial Information repository by the JWC will provide NATO with a much more robust capability to support defence planning."

all previous records, both in terms of the number of requests and the volume of data served. Altogether, over three million requests were registered. To put this into perspective, we received, for example, 10-, 20-, 30- or even 40-requests per query, from a single user. During an average exercise, the number of queries would exceed 30k and an average of 2,000 queries a day. In order to display all these requests simultaneously, you would need a 370m diagonal screen. If printed, this equals over 62.7 km of normal "map" paper (1,372 rolls)—not the best contribution to sustaining the precious rain forest! The Geo team used a similar product for exercise TRIDENT JAVELIN 2017 to improve our processes and help prepare data.

Photo by JWC PAO

Hardware and process improvements

The implementation of IT Modernization (ITM) continues to have a profound effect on how the JWC works, especially for those who work primarily in the digital environment. In addition to being the custodians of nearly 40TB of Geospatial Information, the Geo team recently received 80TB of external storage and 6 x 4TB USB thumb drives. This storage is currently being used to safeguard Geospatial Information and transfer data to/from servers across the NATO Command Structure, ensuring no adverse effect on critical network bandwidth and storage under ITM.

In 2017, the Geo team produced over 1TB of Geospatial Information data in-house. Soon after, during the preparations of TRIDENT JUNCTURE 2018, an important procurement of two high-specification laptops was made. These proved cost saving and continues to be an important investment for all GIS processing.

Summary

GIS plays a pivotal role in military operations. The concept of Command and Control, communication and coordination in military operations is largely dependent on the availability of accurate geospatial information to arrive at quick decisions for operational orders. In the present digital era, GIS continue to revolutionize the way in which NATO operates. Intelligence, battle space management, terrain analysis and remote sensing are all heavily GIS dependent. Lastly, the team in the Geo cell is a modest one, who would like to leave the final word to Albert Einstein: "As a young man, my fondest dream was to become a geographer. However, while working in the Customs Office, I thought deeply about the matter and concluded that it was far too difficult a subject. With some reluctance, I then turned to physics as an alternative." ✧