PRODUCING AN ORIENTEERING MAP   Bill Anderson, May 2012

An **orienteering competition map** is a highly detailed representation of an area's topography, vegetation, water features and other natural and man-made objects. It's a super topo map! It's purpose is to provide a good test of navigation - at speed!

It must absolutely:

1. be accurate and up to date;
2. contain a level of detail suitable for precise navigation but also be easily readable;
3. meet the ISOM standards for symbol sizes, shapes, and colours;
4. be consistent in it's representation of the detailed objects over the whole map.

I could get into a long dissertation on all of these topics but I think I have made my point. Just to state it another way - orienteering is not fun on a low-quality map.

All the new technologies coming out are only aids in producing a high quality map. Making a good orienteering map requires a lot of leg work and drawing time. Having said that, here is my take on what you need to do to make a good orienteering map. There are four main steps.

1. Find an Area Suitable for Orienteering.

Key requirements include:

1. Is the terrain suitable for orienteering fun? e.g. Good "runability", lots of objects to find, trails for beginners, nice woods, etc.
2. Are there good access and staging areas for parking, finish areas, etc?
3. Can you obtain ownership permissions? Are there seasonal restrictions, environmental concerns, etc?
4. Distance for populated areas - putting a lot of work ($$) into a very remote area may not be practical.

Who can do this step? - It's practically a prerogative for all active orienteers to look for new areas for orienteering. Once an area has been identified, club members can start a more formal review of the terrain, contact landowners for permission, and resolve the access concerns.

How much will it cost? - At this point, only time. Calendar time and person time. Depending on the ownership and access issues, maybe a lot of time. Maybe months. But we have to keep looking and asking.

2. Building the Base Map.

This is easily the most convoluted part of the whole map-making process.

The "base map" is the starting point for the creation of a good orienteering map. It may be a **good** old orienteering map that is out of date, but it is NOT a government topo. They have only generalized topographic detail and are usually hopefully out of date.

2.1 Obtain the Topography

Now, if the area you plan to map is flat, you might get lucky and find that the Google or municipal photo of your area has a high resolution and shows a lot of detail. That might do for a school yard or park map. But I want to focus on producing a competition-quality map.

How much topography detail do you need? If the area in question needs a 5m contour interval to provide a good orienteering challenge (i.e. hilly areas), you will need an accurate topo base with 2.5m contours. This will assist the field checker to make adjustments to the contours for readability and to add accurate form lines. If finer topo detail is available that's great, but it will cost more.

The same rule applies for flatter areas or sprint maps. Try to obtain the contour detail to at least double the finished product. e.g., for a 2m sprint map you will need 1m base contours.

Who can do this step? Commercial base map companies. The original and still-in-use method for obtaining topographic detail is by taking stereo aerial photographs (a separate air photo company) and generating the contours using photogrammetry (commercial base map company). The same photographs are used by the technician to pick out and trace vegetation and water features. The main drawback with this technology is that the technician must be able to focus on the ground - not always possible in heavily forested areas. The limit for accuracy (again depending on the ability to clearly see the ground in the photo) is probably a 2m contour interval.

The modern technique for generating topographic detail is LiDAR. Light detection and ranging. If you received a speeding ticket lately you were caught by a LiDAR gun! It can also measure distances to the ground from an aircraft very accurately, in any weather, and through forest cover. As such, an air photo company with LiDAR equipped aircraft can produce a data file of the surface elevations (to a specified density) for a given area. Mapping software, including OCAD, can then generate contours from this data to virtually any practical interval. Like the aerial photogrammetry, you will pay more for higher definition, but the per Km. cost of the higher quality LiDAR topography is half the older photogrammetry-based method.

How much does it cost? - Refer to the Cost Summary Table at the end of this document.

2.2 Obtain the Air Photos

To produce a good quality map you need the digital file or paper print-out of the area's topography (as per above) **AND** high resolution (and current!) aerial photographs that show the

"objects" on the terrain. The photos must be taken when the leaves are off the trees so "in-forest" details are not hidden. Even then, from my experience, you will only be able to locate 50% or less of the "mappable" details in the best photographs. The remainder must be found and plotted by "leg and eye". Orthophotos taken with the LiDAR flights or the stereo photographs used in the photogrammetry are extremely valuable for confirming field checking. Objects that were missed on the initial viewing will become recognizable when located "on the ground". Google photos are getting better all the time too. Sets of photos taken at different times of the day and year may reveal more in the shadows and by their colour.

Who can do this step? Commercial operators or experienced mappers. My club is moving away from the old photogrammetry method and only purchasing LiDAR data and orthophotos from the local municipalities - when available. They sell the data files to us in 1 sq. Km. geo-referenced segments. Using OCAD and other mapping software, members of our club have learned to generate the contours and derive other objects (vegetation, water, possible cliff, etc.) using the intensity parameters of the LiDAR data to create great base maps. Sometimes it takes a visit to the area to be able to fully interpret what can be generated from the LiDAR data.

For a presentation on how we (the Ottawa Orienteering Club) use LiDAR data for our base maps go to the link on the main wgacarto.ca page.

How much does it cost? See the Cost Summary Table for the various options.

2.3 Create the Base Map Drawing on a CAD (Computer-Assisted Drawing) file

Having obtained the topography and photo files (or prints) a mapper can now create a base map in OCAD. I recommend OCAD because it is simply the best software product for making orienteering maps. You can use other CAD products (or combination thereof) but you will probably be wasting your time. Version 11 of OCAD Standard costs about $650 CDN.

Who can do this step? It takes some training and experience with OCAD to build the base OCAD map from the topography and photo files. If the topography (contours) are from an object-based geo-referenced file (or LiDAR data), and the photos are also in a geo-referenced and digital format (orthophotos), there are OCAD functions to simply line everything up you can get started with adding field-checked details. However, things are often not so straightforward, and the mapper may have to scan, import, re-scale, and then manually trace the base information onto an OCAD file. There are no short-cuts to producing a good base map. Money and time spent now will be easily recovered while field checking and drawing. $50 spent on the base map is worth $100 later.

How much does it cost? See the Cost Summary Table. It depends on what the base map developer is working from. Less if she has digital files she can simply import and convert into the OCAD format. More if she has to spend time tracing the non-digital base images onto an OCAD map file.

3. Perform the Field Checking and Add Details to the Base Map

This the most time-consuming (and thus, costly) part of the process. It requires patience, persistence, reasonably good weather conditions, a lot of computer time, and a love of the outdoors. However, the techniques are straightforward and can be learned by any experienced orienteer. I say orienteer because they will have experience with existing maps and have a better understanding of the level of detail required on an orienteering map. This is the step that can be the most frustrating but it is the most rewarding when complete. A new work of art!

In a nutshell, the mapper covers the whole area (back and forth, or in small segments) with a large-scale paper copy of the base map and adds (notes, or draws in) the natural and man-made detail not on the base. At the end of each field session she traces the notes from the field onto the OACD file. Light-weight, long battery-life tablet computers are now available that run OCAD (Windows) so the field "notes" can be added directly to the OCAD file - saving tracing time.

Orienteering mappers must learn to make adjustments to fine, hard to read, base map features so they become more obvious to the competitors. When readability or symbology questions arise, there is a well-establish set of mapping standards (ISOM and ISSOM for sprint maps) that can be used.

Who can do this step? Any experienced orienteer can learn to field check and draw maps. There is a reasonably long learning curve to be able to do it efficiently but it does not require any extraordinary skills. The first step is usually to make minor updates to existing maps and then move on to developing new maps. I offer workshops for new mappers. Check the links on my main page.

Commercial Mappers - There are very few commercial orienteering mappers in Canada - or even North America. If you have a major project and need help, you will have to check with the Canadian Orienteering Federation (or OUSA) for a list of available mappers. The experienced mappers are always booking **years** in advance!

The other option is to hire a European orienteering mapper - there are several full time mapping companies over there. You will usually have to cover the travel and accommodation costs for any mapper you employ.

How much does it cost? - Refer to the Cost Summary Table

How long does it take to field check and draw an orienteering map? This is probably a better question since the cost is virtually all man-time. Anywhere from 4 to 8 days per sq. Km. - depending on the quality of the base map and the level of detail to be mapped. Flat, almost featureless areas are much easier than rugged, highly detailed areas. Experienced mappers will only make firm quotes based on site reviews with the existing base map.

4. Final Map Production

There are several tasks remaining to finally complete the map - ready for competition. There is the legend, titles, credits, North-South lines, framing, logos, etc. to be added. There may be different scale versions of the map to be generated depending on how it will be used. The symbol standards for a 1:5000 or 1:4000 sprint map are slightly different than the smaller scale maps - so another version of the map will be required.

Print Quality - After all the hard work, it bothers me when the users (meet directors, etc.) of good orienteering maps don't take the time to print the maps on a high quality printer. As a final product, a mapper should produce several sample maps from a high resolution printer or commercial print service as an on-going standard for the club(s) use of the map. High resolution graphics with bright, dense colours (to ISOM standards) are requisites for a great orienteering map.

Who can do this step? Anyone with some OCAD experience can complete these tasks.

How much will it cost? Not a lot, and a well laid-out and quality-printed map makes orienteering much more fun!

COST SUMMARY TABLE

Unless otherwise noted, the costs are based on a sq. Km of data or product. There are options for each step. The totals are based on the best options currently available to us in Ottawa.

1. Find a Suitable Area for Orienteering			
Travel Costs for club members?			See note 1.
2. Build the Base Map			
2.1 Obtain the Topography			
Buy the LiDAR data from municipality		$100	See note 2.
Order flights for LiDAR data or stereo photos	$200?		See note 3.
Order Photogrammetry plots from stereo photos	200		See note 4.
2.2 Obtain the Air Photos			
Buy the orthophotos from the municipality		25	See note 5.
2.3 Create the OCAD Base Map Drawing			
Build with LiDAR data and orthophotos		100	See note 6.
Trace the photogrammetry plots to OCAD	50		See note 7.
3. Field Checking and Drawing			See note 8.
High quality survey of "easy" area (3 days/Km)		600	
HQ survey of gentle, fairly detailed area (4-5 days/Km)		800	
HQ survey of hilly, thick, detailed area (6+ days/Km)		1200	
4. Final Map Production		25	
Total "ballpark estimate" for a good O-map		$1050	See note 9.

1. Clubs should consider covering at least some of the travel costs.
2. There may be other sources for LiDAR data - provincial govt., utility companies, etc.
3. This a guess. We haven't ordered flights since 2006. It's prohibitive unless you fly large areas.
4. Air photos are sent to a photogrammetry service where they create digital images for tracing. They also draw the other land and water features that they can see clearly.
5. We pay $100 for 4 sq. Km segments. They are usually more recent and have a higher resolution than Google photos and are also geo-referenced.
6. We have tech-savvy club members who perform this task. They typically spend 4- 5 hours per sq. Km tracing vegetation, water features, and locating other "probable" form features and cliffs.
7. Some mappers work from the photogrammetry plots in the field and then do the tracing.
8. Commercial orienteering mappers charge $26-$28 per hour. I have rounded it to $200/day. The mapper at the last WOC in France spent 8+ days per Km in that very detailed (and thick) area.
9. My usual, generalized, "off the cuff" response to "How much does it cost to make an orienteering map" is $1000 per square Km. Then we get into the specifics of the area and source (base) material.

FREQUENTLY ASKED QUESTIONS

1. I just want to make some simple orienteering maps for beginners and students in the parks and school yards. I don't have a budget, OCAD, or any mapping experience.

Answer - OK, I fabricated the question, but it is a conglomerate of many that our club receives from schools and other groups. Providing simple but quality orienteering maps for these groups is the responsibility of our O-clubs. There is usually someone in each club with OCAD and/or mapping experience that could develop maps for other groups - the problem is the time (availability) and cost.

Schools that I have worked with have found the funds (a few hundred dollars) to develop a map of their school yard and/or local park. They are great projects for the young orienteers in our clubs.

2. We can't afford to fly our own (stereo photos or LiDAR data) - where else can we get the topographic info and photographs

Answer - some provinces have reasonably large scale topo maps (1:10000, 5m contours) but they are typically not up-to-date and the contour data is rounded**.**

The best source is the municipality planning office. They will have the latest mapping data. Tell them you need the data to make orienteering maps and that it's non-profit recreational activity that everyone can enjoy.

3. Are old orienteering maps good as a new base?

Answer- that depends on the quality of the old map. If the basic topography is good (accurate (undistorted), sufficiently detailed) it's probably a good starting point. Our 30 year old maps of the Gatineau Park developed from the park's topo maps are going to be replaced with contours from new LiDAR data. Updating/adjusting poor contour data is a very time consuming and frustrating job.

4. Who can provide the photogrammetry services?

Answer - the company we have used the most in the past is www.stirlingsurveys.co.uk

There is a LiDAR base map company in the US called Red Arrow Maps at: http://www.lidarbasemaps.org/ that make orienteering base maps. I have talked to them but have not used their services. There may be others - Google "LiDAR base maps".

5. How much should we pay novice mappers to do work for our club?

Answer - It takes, I would say, several months of field checking and drawing to be really efficient. So paying a new mapper $25+ an hour is not practical. The best way to price a mapping job for a less experienced mapper is by the area. For example, using the guidelines in the Cost Summary Table, each Sq. Km. of a gently rolling, detailed area will cost approx. $800. Of course, the quality of the work will have to monitored by an experienced orienteer.