GIS / GPS ROAD INVENTORY

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ABSTRACT

With recent moves in Papua New Guinea to create Geographic Information Systems (GIS) / Asset Management Systems, we felt it necessary to determine a methodology for efficient data capture.

In line with recent technological advancements, "The New Generation" requires efficient digital solutions from data capture to integration of the graphical database / management system.

To this end, we decided to trial "New Generation" GIS orientated Global Positioning Systems (GPS) equipment. This coupled with modern software packages means the transformation of GPS data to a digital geographical database is relatively easily achieved.

The purpose of the study was to ascertain the following:

- Equipment compatibility,
- System requirements for GPS / computing / software,
- Data accuracy,
- Ease of use,
- Time and costing,
- Standard coding requirements,

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INTRODUCTION

With PNG and surveying in PNG becoming more technically orientated and the demand for GIS products, especially after the GIS Seminar held in Port Moresby earlier this year. We were enthusiastic with the idea of becoming more involved in the GIS sphere of surveying and data capture.

The opportunity arose when we were requested to do GPS control surveys in Madang Province. Having a vehicle that needed to be transported to Madang, and siting in Lae, we bit the bullet and decided to GPS the road from Lae to Madang and pickup the road furniture enroute.

Having been given the green light for the control survey we approached National Mapping Bureau and the ACLMP to hire their Ashtech Reliance GPS unit. Unitech and NMB we both requested to run their base stations over this two day period of data collection.

Asia Pacific Surveys have 2 geodetic quality Topcon GPS units. The intention was to use one as a rover along with the Reliance and one as a base station in Madang. This in theory would give a check on the Reliance and also give accuracy tests with both the other two base stations. All didn't go to plan.

EQUIPMENT COMPATIBILITY

Having done geodetic surveys with the Topcon in Port Moresby and using NMB as a base station, the two systems were compatible when using the Topcon software for post processing. Here it ended for the Topcon. When using the Ashtech Reliance software, it wouldn't accept the Topcon rinex format. Once again problems occur with rinex compatibility. The strange thing is Topcon accepts Ashtech rinex format. (The rumour is that the manufactures of the Topcon once worked for Ashtech). From previous experience, there has also been problems with Trimble to Ashtech, Ashtech to Trimble and Garmin to Ashtech with rinex formats.

This was the first assumption that we made and were wrong. Next time we use only the Ashtech equipment or something that is known to be compatible. It is a advantageous to have two base station that will observe when requested, and are compatible with each other.

EASE OF USE

The Reliance is a relatively easy GIS GPS unit to use. There were some problems with the antenna, but I think it may be due to bouncing it of the roof and dragging it for a hundred metres or so! I don't recommend this for it is a costly exercise to replace.

The Reliance has a few quirks, but if you know what they are and do the QA bit, these can be overcome. Having a data logger, which the Topcon doesn't, is a time saving factor, let alone easier when computing the results. With the Topcon, manual entries in a field book were needed. The time and feature has to be entered, whilst the Reliance a code only be entered. This can be done either in long hand or encrypted code, which is much faster and easier.

Loosing lock, was a huge problem with the Topcon. It is basically designed as geodetic instrument that can do on the fly, but this didn't prove satisfactory in

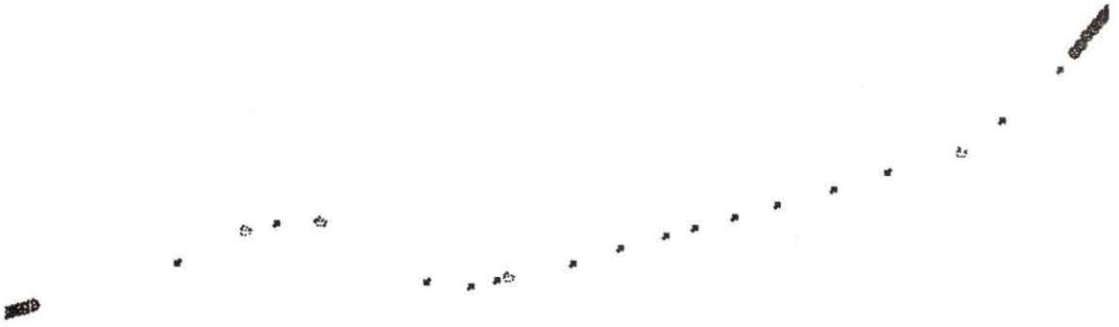
vegetated and hilly areas. Hence the data was never processed, believed a waste of time and a lesson learned. The Reliance never lost lock, down to one and two satellites occasionally, but this meant that the unit would not record if there weren't enough satellites or the geometry was bad ie PDOP.

DATA ACCURACY

When the data was first post processed, only NMB's base station was used. This looked OK, but it seemed that at two stages the Reliance didn't record a few kilometres of road. Yet the culverts and other road furniture picked up seemed OK.

It was interesting after receiving and processing with the Unitech base data, by itself once again looked great, but only one section of road centre line was missing. This was a concern, after inspection, it was found that the missing section of road was at the end of one day and the beginning of the next, yes you guessed it, the finish point was wrongly identified the following day. What happened to the QA, no flagging tape and wrong high-tension power line crossing the road!

Below is the other section of road that was missing, note that there were features logged, but not the centre line. Why was this?



After closer examination using the Lae base station the centre line was logged, as seen below at a selected part of the road.

Note the two culvert positions, they are about 20m apart. The reason for this is, using NMB data the Reliance was not tracking the same satellites. Therefore a solution was not automatically computed for the centre line because the SD's were over 10m, but at the culvert, where a position was manually requested and a solution was computed. The SD's computed from NMB are .03, .03 and 1.0 metres while from Lae they are .003, .003 and .008 (Long, Lat and Height), and the height different by about 46m. At first glance both are acceptable, but with further investigation the NMB data set is incorrect. This is an assumption, based on the centre line data that was computed from Lae.

Throughout the exercise, the differences between the Lae and NMB data sets varied in position from 0.3 to 20m in position and from about 1 to 46m in height.

Overall the results could be used from either set, dependant on what the data was going to be used for, eg most probably OK for road inventory or controlling Landsat imagery.

TIME AND COSTING

The original estimate for picking up all the detail on the road was two days. How wrong we were, to do the pickup comfortably there should have been three to four days allocated. That is if all the road furniture; power lines, mileage posts signs, schools, villages, culverts, (their condition, size, construction and the number of pipes) etc were required.

Things to take into consideration are:

- Vehicle and driver
- Operator
- Accommodation
- Positioning of a base station close to the area to be detailed plus operator
- NMB and Unitech base stations for gross error checks

- Air fares
- Computing time
- Analysis of results
- Presentation etc

The actual cost to a client to produce the information would be quite high considering the amount of work involved and the backup required when producing a quality product.

STANDARD CODING REQUIREMENTS

To make things simple standardised coding is required. Time is money and just the same as you have standard coding for your total station when importing the data into Civilcad, Geocomp or whatever software package is used, the same must apply to GIS GPS pickup.

If each surveyor was to have his/her own coding format, the amount of programming time needed to convert the information into a standardised format for importing into MapInfo or what ever front end GIS software is used would have each survey company developing software for this purpose. This would not be chargeable to the client and we all don't like doing work and not being rewarded for it.

SYSTEM REQUIREMENTS FOR GPS, COMPUTING AND SOFTWARE

- GPS
  - The equipment used should be compatible with the permanent base stations. If not, then the features to be picked up would need to be done twice. Why? Gross error checks, this was proven by our two results and not having two base stations means radiations and as professional surveyors radiations without checks can lead to huge problems and law suits.
- Computing
  - With the amount of data collected in a day, the standard notebook of yesterday

that has a small amount of RAM and a 486 chip is not suitable. The time that it takes to compute a days work varies greatly by the speed of the computer and the amount of RAM. Having computed the same data on different systems, the time saving factor on a modern computer is immense and once again this is a cost saving for the client let alone the surveyor who has to stay up half the night to verify the data.

- Software
  - Each GIS GPS has its own software package, this is fine but, what about the conversion to the front end GIS software. Yes this can be done manually in spreadsheet format but what of the time and errors that can occur. Through experience doing it both ways there is only one solution, a standard bit of software for each type of GPS manufacturer that converts the standard code used and transports the information in to standard tables for the GIS interface.

CONCLUSION

What needs to be addressed is standardisation with coding, interfacing software and the GIS table formats. From previous experience, a different requirement for different surveys makes life interesting, the software was rewritten to accommodate each project. Therefore a standardised package is required that makes all our lives easier.

Base stations are another requirement, are the two permanent stations always going to be available and is the data going to be kept at a reasonable cost?

Thought must be given to the full process of the project, in the past there has been people that just pick up a GPS and do a survey. The manufactures and retailers say it is easy to operate, which it usually is, but there is never a mention of the analysis of the data. In too many cases what the computer or instrument spits out is taken as gospel and you can come unstuck very easily. This will cost you some of your good will, reputation and most probably a few kina as well.

If venturing into this field, think twice and get some advise first, ask the people who have already made the mistakes and lost a few kina trying to sort out the various problems that will crop up time and time again.

When doing a GIS survey, make sure that there is enough redundancy to achieve the required results.

ACKNOWLEDGEMENTS

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