HEXTA Electronic Targets for Belmont

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In 2013, four Belmont based clubs: Brisbane Mariners Rifle Club (the lead agency); Natives Rifle Club; Pacific Rifle Club; and University of Queensland Rifle Club - formed an Electronic Targets Syndicate to apply for a Queensland Government grant of $100,000 through the "Get Playing" initiative of the Department of National Parks, Recreation, Sport and Racing (NPRSR). The grant was conditional upon the Syndicate clubs each making a financial contribution to the purchase of the electronic targets system; the Syndicate clubs contributing in-kind voluntary labour of $46,800 to the project (already exceeded); and spending all of the grant monies by December 31, 2014.

In support of its application for funding, the Syndicate advised NPRSR that the introduction of electronic targets at Duncan range was expected to generate a range of flow-on benefits for fullbore target rifle shooting. These included enhanced support facilities, retention of existing membership, improved community engagement through better use of facilities at Belmont range complex and attracting technology-savvy younger people to the sport. In addition, an influx of shooters from Australia and overseas is anticipated in the lead-up to and during the Commonwealth Games in 2018, with a commensurate increase in demand for target availability during practice.

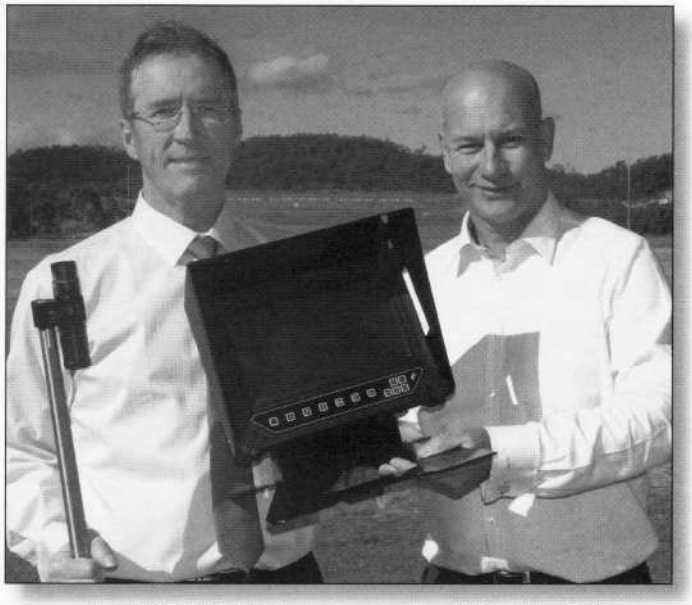
NPRSR was not overly prescriptive in how the Syndicate went about selecting an electronic target system for Duncan Range at Belmont. Nevertheless, the Syndicate considered that it should have an open and fair tendering system (commensurate with state purchasing guidelines) to attract the widest possible field of potential tenderers and develop tender selection criteria which put its final choice of an electronic target system beyond doubt.

To ensure commonality of objectives, the Syndicate's first task was to draft and execute a *Heads of Agreement* among the Syndicate clubs to purchase, install and commission the electronic target system in 2014 and, from 2015 onwards, oversee the management of electronic targets.

In February, the Syndicate produced its *Request for Tender and Attachment A - Statement of Work* (RFT). It would be remiss of the Syndicate not to acknowledge the prior electronic targets work of NRAA and Canberra Rifle Club, which both made resources available to the Syndicate to assist them in preparing these documents.

The Syndicate invited five Australasian firms to tender (the Syndicate was not required to advertise the tender in the print media) for the electronic target system, in accordance with the terms set out in the RFT.

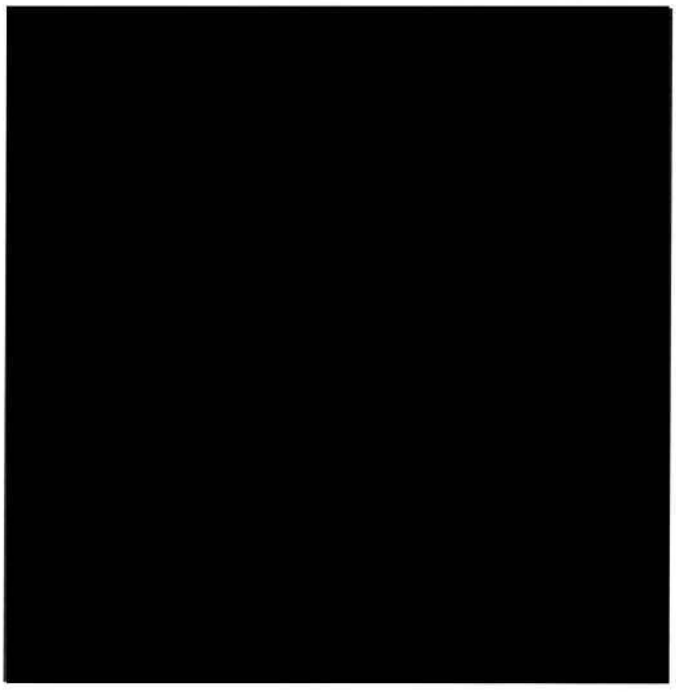
In March, the Syndicate produced its *Protocols for Field Testing of Tendered Systems* to evaluate the



Bruce Daniel, HEX Systems with Steve Minnikin, MP

tendered systems at Duncan Range. These *Protocols* were to be in addition to the weightings (e.g.: value for money) usually applied during tender evaluation. The *Protocols* were circulated to potential tenderers and following consultation the *Protocols* were enhanced by an *Addendum*.

On April 23, 2014 the Syndicate selected HEX Systems Pty Ltd as its preferred tenderer for the electronic target system. Another firm did tender but their tender was non-conforming relative to the Syndicate's tender requirements as set out in the RFT. The HEX system was then required to be demonstrated and field-trialled in accordance with the Syndicate's *Protocols*. These



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Back row (L-R) John Menzel, President of Natives Rifle Club and MDRA, John Caske member of Natives Rifle Club, J "Johnno" Johnstone, President of University of Queensland Rifle Club. Front row (L-R) Andrew Mayfield President of QRA, Bruce Daniel Marketing Manager for HEX Systems Pty Ltd holding the HEX scorer's monitor with Steve Minnikin MP

field trials were conducted between May 7 and 9, 2014. In June 2014 the Syndicate entered into a contract with HEX Systems Pty Ltd to supply a twelve-target electronic target system (with spares) for Duncan Range. The Syndicate has also entered into an Escrow Deed with HEX and their software developer to ensure the Syndicate will be able to access the operating system for the next eight years.

Under the contract, HEX has 15 weeks to deliver the electronic targets and system to Duncan Range. The date of Practical Completion is October 17, 2014. Final Completion is set down for December 11, 2014.

Between these key dates HEX will be required to stand up the electronic target system at Duncan Range and prove its viability to the satisfaction of the Syndicate clubs.

Following the field trials the Syndicate produced a report of its findings and these are reproduced for the most part in the discussion which follows.

The Field Trials

Setting Up

On May 8, 2014 the staff from HEX Systems - Proprietor Dmitri Kazakov, Marketing Manager Bruce Daniel and Field Engineer Ted Boreham - demonstrated the installation and setup of the system. Syndicate members had the opportunity to assist and found that the target was easy to handle with two people.

The Test Method

Tests were performed at 300 yards on the Thursday and at 1,000 yards on the Friday. Weather conditions were fine with some gusting winds up to approximately 12/16 knots - particularly on the Thursday morning.

Calibres used were .308, 5.56 and 7 mm. The .308 ammunition used throughout the trial was factory Winchester. All shooters were F Class using stands.

Four different types of tests were performed:

Accuracy - 300 and 1,000 yards, shots spread across target face.

Accuracy of grouping - 300 and 1,000 yards, shots aimed at centre of target.

Accuracy with two (of eight) sensors disabled - 1,000 yards, .308 only.

Multiple concurrent shots on target - pairs of shots with different calibres fired simultaneously (at 300 yards) and at two and four second intervals (at 1,000 yards).

For the spread-shot tests, a full-sheet (2400 x 1200 mm) corflute test panel was attached to the target face. For the grouping tests, standard HEXTA corflute aiming mark panels (approx. 1100 x 1100 mm) were used as test panels. ICFRA aiming marks were glued to the test panels.

The HEXTA target had vertical and horizontal registration marks on the frame that indicate the electronic centre of the target. According to the HEX Systems engineers the electronic centre of the target is set at the factory and does not drift over time.

When positioning each test panel on the target, care was taken to align the centre of the aiming mark with these registration marks as closely as possible. Vertical and horizontal axes were then marked on the test panel. In practice, however, the Syndicate found that perfect alignment was unachievable. A correction method was applied to the results to compensate for misalignment.

After each shot, Syndicate members lowered the target

and measured the shot position from the vertical and horizontal axes. Measurements were entered directly into an analysis spreadsheet as they were taken. Each shot was plotted on a plot sheet at the butts, and was used later to identify individual shots for re-measurement.

After completion of the tests, all measurements were repeated with the test panels laid flat on a table. Measurements were taken on the back face of the corflute panels because the exit hole was found to be smaller and more well-defined than the penetration in the front face.

The HEXTA log file for each session, containing the X and Y coordinates of the shots, was copied to a PC and the data entered into the analysis spreadsheet. The spreadsheet automatically calculates the error (difference between measured hole position and ETS coordinate) for each shot in the X (horizontal) and Y (vertical) directions. It also calculates the Standard Deviation of these errors for each Serial or group of Serials in both directions (SD X and SD Y).

Standard Deviation

Standard Deviation (SD) indicates the spread of error results about a mean or average value. With the target and aiming marks perfectly aligned the mean value in X and Y directions would be zero. The spread of error results forms a "normal" distribution about the mean - in other words a "bell curve" distribution - in the X and Y directions.

A low SD indicates that the results tend to be very close to the mean, whereas a high SD indicates a wider spread. In a normal distribution 67% of results are expected to fall within one SD either side of the mean. For example, an SD X of 1 mm indicates that 67% of shots will have an error in the X direction of 1 mm or less.

Correction for Misalignment of Aiming Mark

As already mentioned, it is not possible to perfectly align the physical centre of the aiming mark and the electronic centre of the target. Each time an aiming mark is fitted the misalignment will be different. In accuracy measurements it is essential to apply correction otherwise the misalignment will add to the calculated error result for each shot and the target errors will appear to be higher than they actually are.

The accepted correction method is to calculate the average error in each direction and apply this as the correction. Provided the number of shots is not too small, this method estimates and corrects for the misalignment with acceptable accuracy.

Accuracy results and observations

Accuracy test type	Range	No. shots	SD X (mm)	SD Y (mm)
Spread over target	300 y	45	2.62	4.02
Spread over target	1,000 y	45	7.19	4.96
Aimed at centre	300 y	45	0.57	1.43
Aimed at centre	1,000 y	90	1.80	2.65
Two sensors disabled	1,000 y	20	1.69	1.85

Steve Minnikin checks the target watched by Andrew Mayfield and Bruce Daniel, HEX Systems

These results represent a close alignment between the recorded data and the expected mean. It was noted that wider hits on the target produced greater errors. Consequently the SD was larger when the shots were spread over the target.

The results with two of the eight sensors disabled represent a surprisingly close alignment at 1,000 yards between the recorded data and the expected mean. There was no detected degradation in the accuracy of the target system with the removal of two sensors.

Afterwards the Syndicate members worked with the HEX Systems representatives to re-measure all the shots. This re-measurement exercise provided a slightly more accurate set of results and resulted in a closer correlation between the electronic results and manually recorded results.

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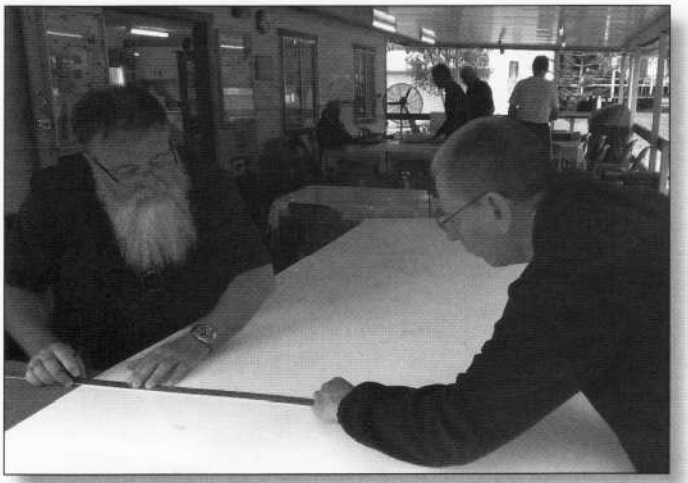
Measurement verification	Range	No. shots	SD X (mm)	SD Y (mm)	SD X (MOA)	SD X (MOA)
Aimed at centre	300 y	45	0.60	1.06	0.007	0.013
Aimed at centre	1,000 y	90	1.77	2.48	0.007	0.009



Syndicate members Rod Reeves and Richard Kenny performing check measurement on a test panel

The results at both ranges were considered excellent. Expressed in minutes of arc, the SD was in the range 0.007 - 0.013 MoA.

The average correction for misalignment of aiming marks was 2.44 mm, and the maximum was 4.63 mm.

Concurrent Shots Results and Observations

At 300 yards, two concurrent tests were performed: Detail 1 was .308 and .308; Detail 2 was .308 and 5.56.

For both tests the ETS recorded only the first hit on the target. This was expected as the acoustic sensors can only interpret one sound wave entering the sound chamber at a time. The first hit was correctly registered with the X and Y delta variances recorded as follows:

	Delta X	Delta Y
Shot 1	1.2mm	0.4mm
Shot 2	0.9mm	1.2mm

At 1,000 yards two tests were performed, both using .308 vs 5.56. Detail 1 had a two second delay between shots, while Detail 2 had a four second delay.

In each test both shots registered correctly.

Other Observations

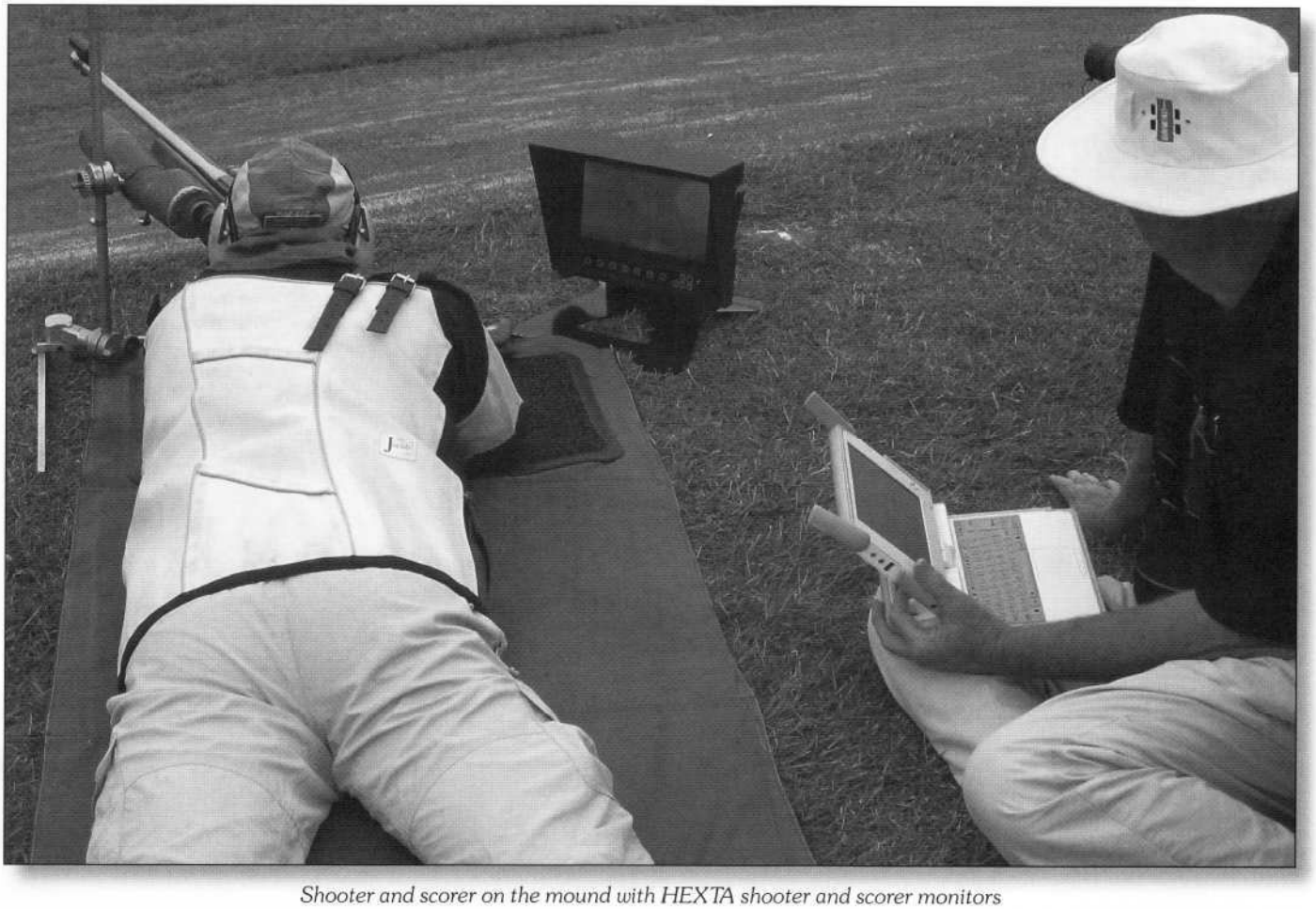
Apart from the performance aspects, the Syndicate noted numerous other stand-out features of the HEXTA targets:

Innovative target design incorporating eight acoustic sensors, enabling up to 56 calculations of each shot position. This significant redundancy allows greater accuracy in the determination of shot location, even in the event of a sensor failure or damage.

Use of Wi-Fi technology for all system components. No cabling is required between any of the system components. All Wi-Fi links are fully EMC compliant. Any Wi-Fi enabled device with web browser access (e.g. smart phones, tablet PCs etc.) can be connected to the system as a spectator terminal that can view any target on the range.

All system components are battery operated, so there is no need for mains power at the butts or mounds.

State member for Chatsworth, Steve Minnikin, presenting the grant cheque for $100,000 to BMRC President Richard Kenny (left) and MDRA President John Menzel



Shooter and scorer on the mound with HEXTA shooter and scorer monitors

Innovative software development incorporating extensive functionality to support the requirements of shooters, scorers, event controllers, central administration, system maintenance and health checks. The software is developed in Sydney and the development cycle has seen regular updates and enhancements to current customers to date. There is strong evidence of proactive development of new features and customer requested features appear to be promptly addressed where practicable.

Each target operates independently, so a fault in one target does not affect the others nor the operation of the overall system.

All results can be uploaded to a central online database, providing a complete shooting history that is easy to access.

The system is developed and manufactured in Australia.

Conclusions

The Syndicate established through the two days of field trials that the HEXTA-002 Target System performed with a high degree of accuracy and reliability at both 300 yards and 1,000 yards. As a result of the trials, the Syndicate is confident that the system will prove to be suitable for the highest levels of competition at the Duncan Range.

There was no difference in accuracy of recorded hit information regardless of the calibre being fired, i.e.: .308, 5.56 or 7 mm. It was noted that the accuracy was lower for hits further from the target centre.

At 300 yards there were a total of 45 aimed shots at the target centre and the standard deviation measured across this whole group of shots was X 0.60mm and Y 1.06mm.

At 1,000 yards there were a total of 90 aimed shots at the target centre and the standard deviation measured across this whole group of shots was X 1.77mm and Y 2.48mm.

The Syndicate wishes to express its appreciation to HEX Systems representatives for their support of the trial, the time and effort they put in, and for the supply of the sample ETS.