ADM
AUSTRALIAN DEFENCE MAGAZINE
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Land Warfare - US Roundup: Out on Route 76 | ADM Oct 08

01 Oct 2008

(Web link: http://www.australiandefence.com.au/adm/index.cfm/p/archives.detail/objectID/D6B99FE2-5056-8C22-C91737A62C52F356/pageno/1?search=Route%2076&relatedPub=&page=2&exactphrase=)

It's easy to imagine that the challenges faced by Australia's defence industry are unique – but some of them are universal, and the pro-active stance of one US state in particular resonates with that of several Australian states.
Gregor Ferguson

The Commonwealth of Pennsylvania is steeped in history: Philadelphia is the former US federal capital and the city where the US Declaration of Independence was signed.

The Gettysburg battlefield is a short drive away, as is architect Frank Lloyd Wright's iconic Fallingwater building.

More recently, artists like Michael Cimino and Bruce Springsteen, in their films and music, have documented the supposedly terminal decline of rustbelt cities as Pennsylvania steel mills and coal mines closed in the 1970s and 80s.

The picture painted by Springsteen is compelling, but inaccurate – annoyingly so, to the people who actually live in Pennsylvania and have to deal with the outdated perceptions of others.

The state has determinedly re-invented itself as a high-technology research and industry hub, sustained in large part by a burgeoning defence industry, and no more so than in the old steel and coal communities clustered around Pittsburgh in western Pennsylvania.

The parallels with Australian regions like South Australia, the Hunter Valley, Wollongong and Victoria are irresistible.

Like South Australia, to take just one example, Pennsylvania has adopted a 'whole of state' approach to attracting inward investment in new industries – and not just in Philadelphia.

The state has a population of 12 million and lies conveniently between Washington, Chicago and New York.

Accidents of history have left it with a legacy of major defence and aerospace contractors.

As you drive west from Philadelphia along Route 76 you pass close to Boeing, Lockheed Martin and DRS in Philadelphia; BAE Systems Ground Systems just up the road in York; Tyco in Harrisburg; an emerging cluster of primes and SMEs in Johnstown; and one of the world's great research universities, Carnegie-Mellon, in Pittsburgh.

This is backed up by the University of Pittsburgh and between them they have helped sustain the growth of major ICT, biotechnology, alternative energy and defence industries.

Mutual advantage

These firms and institutions have been the core on which other companies have grown.

A critical factor in the growth of Pennsylvania's defence sector has been the benign influence of Congressman John Murtha, Chair of the Defense Sub-Committee of the US Congress's House Appropriations Committee.

Murtha represents Pennsylvania's 12th Congressional District from an office in Johnstown, just east of Pittsburgh.

While his influence on the growth of the state's defence industry has been vital, the consensus among many of the industry executives encountered by *ADM* during an international media tour of Pennsylvania in August was that the defence industry had reached a self-sustaining level of activity.

This was evidenced by the defence-dominated ARMTech 08 industry and technology showcase at Kittanning in Armstrong County, an hour's drive northeast of Pittsburgh, on August 15-17.

Most of the 77 exhibitors there were defence and security companies and research institutions local to Armstrong County and Pittsburgh.

As an indicator of the local defence sector's overall health, several major primes also exhibited: Lockheed Martin, Boeing, Northrop Grumman, Bell Helicopter Textron and DRS Technologies.

They were not selling, one of them told *ADM*, but looking to strengthen their supply chains - checking out potential suppliers and sub-contractors and trawling for innovative ideas, products and partners.

Philadelphia is home to Tyco Electronics, which turns over US$13 billion a year from operations in 25 countries manufacturing complex electronic components ranging from wireless communications systems, IP-based network solutions and copper and fibre optic cables.

As a measure of the scale of opportunities available in the components sector, the company invests around U$600 million a year, or more than four per cent of its revenue, in R&D.

It applies for more than 750 patents each year and its patent portfolio currently consists of some 16,000 active or pending patents.

The company's aerospace, defence and marine business unit, which alone turned over US$600 million in 2007, is headquartered in Harrisburg, Pennsylvania's state capital.

It's product line includes antennas, waveguide components, SIGINT receivers and a range of wireless equipment and networks sold under the M/A-COM brand name.

Electronic components are unglamorous but essential, specially in a network-enabled defence environment; reflecting the scale of the global market Tyco spends more on R&D in this one (admittedly broad) sector than Australia as a whole – Defence, industry and the universities - does on Defence R&D.

Chinook home

Ridley, near Philadelphia, is the home of Boeing's Rotorcraft Systems business: the factory built steam locomotives before being taken over by Boeing in the 1950s; it now builds CH-47F and G-model Chinook helicopters, about half of the V-22 Osprey in partnership with Bell Helicopter Textron) and components for the AF-64 Apache.

With an annual turnover of US$5 billion a year, it is the fastest growing segment of Boeing, employing 4,950 people in Philadelphia alone and a further 4,500 in Mesa, Arizona.

Boeing has three Systems Integration laboratories in Ridley supporting the C-22 and CH-47 families, a low-speed wind tunnel and a major composites fabrication facility.

The company is close to a decision on whether to build a new V-22 manufacturing facility nearby in order to cope with increased demand for V-22s and CH-47s.

Shortly after *ADM's* visit Boeing announced a contract from the US Army for 191 CH-47Fs, with options for a further 24 aircraft, in a five-year contract worth S$4.3 billion.

The total order book now stands at 513 aircraft, including 61 Special Operations CH-47G.

The ADF has ordered three CH-47Fs.

Later this year the Pentagon will re-tender the US Air Force's Combat Search and rescue (CSAR) contract, which Boeing had originally won with its HH-47; winning this contract again would add 141 aircraft to the order book.

Export interest in V-22 variants is growing, especially following the successful first deployment of a US Marine Corps MV-22 squadron to Iraq last year.

Potential military and civil markets are emerging for the V-22 in the UK, Japan, Australia and Norway, where a SAR variant covering the North Sea oil fields would cover 100nm twice as fast as a helicopter.

To bring the current US$60 million price tag down below $54 million the company is considering land-based variants with no blade or wing fold mechanism.

Boeing's self-interest in attending the ARMTech event in August is clear – it assembles aircraft but doesn't manufacture subassemblies on anything like the same scale as during the Vietnam era.

It needs a robust, economical supply chain and companies from Pennsylvania and the three adjoining states compete hard for the work.

BAE on the ground

Much the same issues drive BAE Systems' Ground Systems sector just off Route 76 in York.

The former BMY (later United Defense) facility currently turns out new and reconditioned M2A2 Bradley fighting vehicles and M-88A2 Hercules armoured recovery vehicles – including those which support the Australian Army's fleet of 59 M1A1 IM Abrams main battle tanks – and carries out final assembly test and integration of the M109A6 Paladin self-propelled 155mm gun and M993A2 Field Artillery Ammunition Support Vehicle (FAASV);

BAE Systems Ground Systems employs 5,500 people, including 2,000 in York, which also has stewardship of the company's steel, aluminium, titanium and composites fabrication facilities.

In Santa Clara, California, the company employs 1,630 engineers working on combat vehicle technologies, including the Future Combat System (FCS), modelling and simulation; it has also developed a contender to replace the ubiquitous HMMWV, or Humvee, in the Pentagon's Joint Light Tactical Vehicle (JLTV) program – this will likely be assembled at York if the BAE Systems design is selected.

The 1,040 staff at Anniston, Alabama, carry out armoured vehicle reset and upgrade (Bradley and M113) and track research and production.

While the Iraq and Afghanistan campaigns have sustained ongoing demand for legacy armoured vehicles, the company is teamed with General Dynamics to develop the manned ground vehicle portion of the US Army's FCS; prototyping is scheduled for 2008-12 with full-scale production due to begin at York in 2014.

Much of the armour for the vehicles produced by BAE Systems at York comes from a new company located in one of the massive old Bethlehem Steel Corporation buildings further west at Johnstown.

There JWF Defence Systems employs some 300 staff in an 800,000ft2 monument to a different era in steel production.

It had lain derelict since 1980 until JWF Industries moved in during the mid-1990s.

The company didn't enter the defence market until two years ago, but now some 65 per cent of its US$120 million annual revenue is defence-related.

JWF Defence is one of the few Armour Certified welding and fabrication shops in the region: it flame cuts armour plate in complex shapes, fabricates entire sub-assemblies, and even surface finishes them in its own powder coating facility.

Its customers include BAE Systems, Lockheed Martin, General Dynamics and Kongsberg; with an eye to its own long term future it is a partner of Lockheed Martin Systems Integration at Owego, supporting the development of Lockheed Martin's JLTV contender.

Germans in Pennsylvania

The Kongsberg connection is relatively new: during ADM's visit to Johnstown, Tom Gerhardsen, Kongsberg's President for Defence and Aerospace, opened the Norwegian company's new assembly facility there in a 138,000ft2 building formerly occupied by Victoria's Secret.

There the company's 87 staff will produce the Protector Remote Weapon Station (RWS) under the US Army's CROWS II contract.

Like the nearby DRS Laurel Technologies Kongsberg will concentrate on assembly and manufacturing, rather than design and development. DRS's Johnstown plant was opened in 1986 and employs 900 staff in a 100,000ft2 facility manufacturing electrical products – principally wiring harnesses, consoles and displays – for defence prime contractors including Boeing, BAE Systems and Lockheed Martin.

The Aegis equipment ordered by the RAN for its three Hobart-class Air Warfare Destroyers will include displays and other components manufactured by DRS at Johnstown.

Another local manufacturing services company is Kuchera Industries, which specialises in high speed surface mount circuit card assembly but manufactures a range of other specialist defence components for the majority of the US's prime contractors.

The company employs 240 staff at a 110,000ft2 facility just outside Johnstown who manufacture cable assemblies for AGM-65 Maverick missile warheads and motors, actuators for the High Speed Anti-radiation Demonstration HSAD) experimental missile, cable assemblies for the Naval Aircrew Common Ejection Seat (NACES) manufactured by fellow Pennsylvania company Martin Baker America, AN/AAQ-24 Nemesis DIRCM enclosures for Northrop Grumman, and circuit boards for Raytheon's AMRAAM, JSOW and Paveway guided weapons.

The company has benefited in particular from provisions in US federal procurement regulations which mandate that a certain percentage of procurement funds and sub-contracts must go to SMEs and to companies owned by women and ethnic minorities or employing significant numbers of disabled people.

However, the company's literature makes virtually no mention of the fact a high proportion of its staff are disabled. General Manager Carl Sax emphasised to ADM that defence prime contractors demand value for money and product quality above all else – there's no work, even for nominated minorities, unless that basic pre-condition is satisfied.

R&D focus

Just across the road from Kongsberg, Concurrent Technologies Corporation (no relation to the IT company of the same name) is a very different beast: it's a dedicated non-profit R&D organisation operating across a range of mainly defence-related technology domains: C4ISR, materials science (including armour plate and protective surface coatings), IT networking and environmental management.

Much of its armour plate expertise finds its way via JWF Defense to BAE Systems, Kongsberg and Lockheed Martin.

Among other things, CTC operates a number of centres of excellence (which incorporate extensive test laboratories) on behalf of the US Department of Defense, including the National Applied Software Engineering Center (NASEC), System of Systems Engineering Center of Excellence (SoSECE), Navy Metalworking Center, National Defense Centre for Energy and Environment (NDCEE), and Dept of Defense Fuel Cell Test and Evaluation Center (FCTec).

The company has a nation-wide presence, including three principal nodes in Pennsylvania at Harrisburg, Pittsburgh and Johnstown, which has no fewer than four CTC facilities, including the NDCEE, FCTec and NASEC.

CTC isn't the only defence R&D centre in Johnstown.

The Conemaugh Health System, central Pennsylvania's largest health care provider, is also an active medical R&D organisation with programs under way at its Murtha Neuroscience and Pain Institute to develop treatments and management regimes for Post-Traumatic Stress Disorder among combat veterans, acute pain, especially in the head/brain and spinal column, and the effects of traumatic brain injuries.

Last year Northrop Grumman's Mission Systems Sector opened a small network communications research establishment in Johnstown.

Why?

Principally because the talent was available, according to project manager Bill Moynihan. The company is tapping into a recent phenomenon – the flight from the big cities in search of a better work-life balance.

Johnstown has succeeded in attracting and retaining a sufficient number and diversity of high-technology firms; it offers both the rural lifestyle many crave with a variety of career options and employers, often in interesting and exciting technology domains.

Good growth

Ten years ago it's likely there weren't the number and diversity of such employers necessary to attract and retain the necessary workforce, but the demographics of Pennsylvania are changing, as they have also in places like Adelaide, Melbourne and Perth.

This is a trend which the state governments of South Australia and Queensland, for example, have encouraged and exploited deftly.

The results speak for themselves: in Johnstown alone there are 5,880 defence-related jobs in a city with a population of 24,000, and a wider district that's home to 145,000 people. Bruce Springsteen probably wouldn't recognise the place today.

Further along Route 76 lies Pittsburgh, the original ‘steel city’ and home to Carnegie Mellon University and the University of Pittsburgh.

Both institutions, along with the nearby Indiana University of Pennsylvania, have strong research programs across the traditional and emerging sciences: physics, chemistry, biology and robotics, biotechnology and network-centric warfare.

Cyber security has attracted the attention of Carnegie Mellon University (CMU) researchers, resulting in the creation of CMU’s CyLab in Pittsburgh.

This is a multi-disciplinary initiative involving more than 180 researchers focused on cyber threats and counters.

CyLab works closely with the Dept of Homeland Security’s National Cyber Security Division (NCSD) as well as with the governments of Japan, Singapore, India, Greece and Portugal.

In late August the first meetings were scheduled to take place between CyLab and the CMU campus in Adelaide, to extend the former’s reach into Australia.

In November 2007 CMU’s Autonomous Driving Research Laboratory, a joint venture with General Motors, won the US$2 million prize in DARPA’s Urban Challenge.

This was a showcase for emerging robotics technology, conducted at the recently de-activated (and so deserted) George Air Force Base in California.

The challenge was to design and build a car capable of driving 60 miles in six hours in an urban setting, in safety, while following the road laws.

Only 11 vehicles qualified to take part in this event; of these six completed it, but only three did so in the allotted time without external interventions.

CMU’s entry, a family 4x4 with an integrated sensor, geospatial reference and vehicle control system, finished in four hours, just 20 minutes ahead of the Stanford University entry.

To show this was a realistic demonstration of autonomous control technology, the contestants were given a map, with GPS coordinates and the speed limits on the roads concerned, just 24 hours before the event. Not until five minutes before the event began were they given their mission.

While a key driver for the event was the global road toll of 400,000 car deaths each year at an estimated annual cost of about US$500 billion, the military applications of the technology are obvious, according to co-director of the autonomous driving research laboratory, Professor Raj Rajkumar.

He told ADM that elements of the base technology are being deployed already, and integrated platform sensor suites are very close: CMU is already in discussion with (undisclosed) potential end users.

First responders

A few blocks away from CMU's CyLab is the University of Pittsburgh's Center for National Preparedness (CNP), whose director, Ken Sochats, is also director of the University's Visual Information Systems Center, from which CNP emerged.

While the CNP has developed tools and products to help first responders in specific types of incident, one of its strengths is its visualisation skills: its ability to integrate information, such as the spread of pandemics, and model this and present it to planners and decision-makers.

The CNP isn't working with European or Asian agencies, but collaborates closely with US bodies such as the Center for Disease Control (CDC) in Atlanta and the Dept of Homeland Security.

While a snapshot of a single state's defence industry and research institutions tells only a fraction of the whole story, one very strong impression received during ADM's visit to Pennsylvania was the mutual support between stakeholders at all levels.

The media tour to Pennsylvania was coordinated by the state's Department of Community and Economic development; however, state law constrains very strictly the way public money is spent, so much of the investment in the mission was funded by the Team Pennsylvania Foundation, or Team PA, a public/private partnership designed to initiate and support innovative programs to promote Pennsylvania's economic prosperity.

At a regional level, these organisations work closely with regional bodies: Select Greater Philadelphia; Johnstown Area Regional Industries (JARI); Pittsburgh regional Alliance; and the Allegheny Conference on Community Development.

These in turn work closely with companies and universities in their region.

The impression was one of a seamless organisation whose components pull vigorously in the same direction, driven from the very top: Ed Rendell, Governor of Pennsylvania.

A generation ago much of Pennsylvania was an incipient basket case.

Its re-invention represents something a case study in self-improvement and resonates powerfully with cities and regions across Australia facing similar challenges.

The major difference is one of scale: at 12 million, Pennsylvania has more than half the population of Australia, with an internal economy which reflects this.

And the state isn't focussing exclusively on the defence sector: it is targeting new sectors such as alternative energy, biotechnology and ICT as well as traditional staples like agriculture and heavy engineering.

Gregor Ferguson visited Pennsylvania as a guest of the Commonwealth of Pennsylvania.