





Australian Government Department of Defence Defence Materiel Organisation

OUTCOMES AND FINDINGS FROM THE

ADVANCED MANUFACTURING INDUSTRY

SCHOOLS PATHWAY PROGRAM

CONTRACTUAL PERIOD 2011 - 2014

Report prepared by: Regional Development Australia – Hunter

Submitted to: The Defence Materiel Organisation on 30th June 2014

TABLE OF CONTENTS

Contents

Executive Summary	1
Overview	4
Program Structure	7
Program Activities	10
Communications Report	14
Outcomes	19
Benefits to the DMO	24
Recommendations	25
Appendices	28
Contact Information	29

EXECUTIVE SUMMARY

Executive Summary

The downturn in the total number and performance of students in Science, Technology, Engineering and Mathematics subjects threatens to disrupt Australia's performance across all industries and sectors but perhaps none more so than Australia's Defence Industry. With a growing emphasis on advanced combat management systems, radars, cyber security and systems integration Australia's Defence Industry needs to take steps to expand its future workforce. Despite this increasing need for technical abilities across all sectors the uptake of Science, Technology, Engineering and Mathematics (STEM) subjects in high schools nationally continues a downward trend.

"Australia's mean mathematical literacy performance declined significantly between 2003 and 2012" – Australian Council for Educational Research, PISA 2012

In addition to Australia's performance in STEM declining in the last decade the total number of students choosing STEM subject pathways has also declined leaving a significant gap in the workforce capacity of major Australian projects.



Figure 1: Percentage of Tertiary enrolments (1999-2010) in science from a selection of countries. (Data sourced form the World Bank, 2012)

In response to the continued decline in STEM the Advanced Manufacturing Industry Schools Pathway Program began as a pilot in 2010 with the aim of delivering an **increase in High school students studying STEM subjects**. The contextualisation of NSW Board of Studies curriculum with industry relevance and the improvement to teachers' awareness and understanding of advanced manufacturing skills became the key strategies for achieving growth in subject selection and engagement of young people in Defence Industry careers. The Living Toolkit is a tangible outcome of these strategies. The initially positive result of the pilot has led to the development of a sophisticated and results driven program in 2014 that encompasses the majority of Hunter High schools and has engaged current Defence Industry companies as well as identified emerging companies with strong prospects of working within the Defence space into the future.

The Hunter has proven itself as a reliable region for the development of a Defence workforce capacity building project aimed at High School students as a target market with high technical capacity and an ability to influence study pathways. High schools have responded positively to the projects goals and the local Defence Industry has adopted the project with optimism and enthusiasm; using it as a vehicle for engaging its future workforce, meeting community contribution goals and enhancing the competitiveness of the region in its goal to establish itself as a lead contributor to Australia's future Defence tasks.

Success to date indicates that the ME Program, as it is branded in the region, will secure the Hunter's place within the Defence Industry as local companies strengthen their competitive base through the acquisition of employees prepared for the utilisation of sophisticated technologies. Evidence of this preparedness is the whole of region shift in Higher School Certificate subject selection that is directly attributable to the efforts of the Defence Materiel Organisation's funding.



Figure 2: Data collated from the NSW Board of Studies and ME End of year reports outlining subject selection of Higher School Certificate students in Stage 6. ME schools uptake in Physics has moved from significantly less students studying physics to significantly more students studying physics than the NSW average which has shown gradual decline.

*The AMISPP in the Hunter has successfully been delivered at Independent, Catholic and State High Schools. (See Appendix A)

EXECUTIVE SUMMARY

PROGRAM HIGHLIGHTS

- The ME Program has worked with over 7500 young people since its inception in 2010
- The ME Program partnered with 4 schools in 2010, in 2014 25 schools are partnered in the program
- The ME Program initially worked with 4 Industry partners in 2010 and now engages 20 companies in partnerships and works with many more on additional activities
- Over 4000 students follow the ME Program on Facebook
- The ME Program Youtube channel has gathered over 74,000 views of its Industry based learning and career videos
- 17% of ME Program students now select HSC Physics compared with the NSW Average of 14%
- In NSW 12% of HSC Physics students will drop the subject before Year 12, in ME schools this rate is just 6%
- 12% of ME Program students now select HSC Engineering Studies compared to the NSW average of 4%
- In 2012 West Wallsend High reported it had enough interest to run its first HSC Mathematics Extension 1 class
- 14% of ME Program students will select Metals and Engineering Certificate II for their HSC compared with the state average of 3%
- Schools running the ME Programs' iSTEM initiative will double between 2014 and 2015 from 7 to 14
- Ampcontrols' apprenticeship intake between 2012 and 2013 increased by over 70%

OVERVIEW

Overview

This report seeks to outline the nature, structure, activities and success of the Advanced Manufacturing Industry Schools Pathway Program as it has operated from 1st January 2011 to 30th June 2014, the extent of the contractual period. Additionally, the report will identify and articulate a strategy to continue the success of the program in line with the goals of the Defence Materiel Organisation.

This report outlines:

- Defence projects of significance to the Hunter in the future
- The structure of the AMISPP program
- The activities conducted under this program
- The outcomes of this program against established benchmarks
- The benefits the program has created for the Defence Industry locally
- Strategies for the refinement, continuation and expansion of the program

The Advanced Manufacturing Industry Schools Pathway Program (AMISPP) has enjoyed Regional, State and Federal recognition since its introduction as a pilot project in 2010. Its initial goals to increase the workforce capacity of the Defence Industry remain as important today as they did in 2010. Through five years of management Regional Development Australia – Hunter has worked with the Defence Materiel Organisation to ensure that the program achieves its intended strategic goals. The AMISPP badged as "ME Program" in the Hunter region has generated unprecedented community support particularly from local industry and education bodies, as well as Hunter based media outlets.

The driving goal of the ME Program is to increase the pool of students studying Mathematics, Science, Engineering Studies, and Physics. This outcome has been accomplished through the employment of the following outputs and related activities:

- Improving the understanding of manufacturing through the promotion of manufacturing careers.
- Providing hands-on learning experiences for students in advanced manufacturing education.
- Establishing student mentoring and networking opportunities with industry
- Establishing a consultative network of local industry and network of schools.

Contextualisation of Board of Studies curriculum with learning outcomes and in-service programs is a strategic objective of the program. This outcome has been accomplished through the provision of career experiences for students with real world challenges and industry-based education work experience. Additionally the implementation of resources across faculty units in key subject areas such as Mathematics, Physics and Engineering Studies are used to promote careers and foster improved understanding of Advanced Manufacturing as a growth industry.

OVERVIEW

In order to achieve program goals it is also a strategic objective to update teacher's awareness and understanding of advanced manufacturing skills. This outcome has been accomplished through the provision of professional development for teachers and career advisors. Teachers now have an understanding of what tools, and pedagogical principles are used and the skills required by industry. This has required teachers to spend time in the workplace in various advanced manufacturing companies in order to develop resource kits to assist and inform other teaching staff within the program.

The ME Program's focus throughout has been on the frontline partnerships of schools and industry. These partnerships account for much of the creativity and vitality of the program. The ME Program review indicates that the program of teacher development in technology and industry awareness has had a noticeable effect on longitudinal student outcomes. The vitality of the teachers and industry partners has delivered much of the program's strength and has had a direct influence on student subject selection.



Photo 1: A student from Callaghan college and education executive explore BAE Systems hangar in 2011

With the Federal Government announcement of increased Defence expenditure from the 2015 Budget onwards the benefits of the ME Program to the Hunter Region and the Australian Defence Industry will soon be actualised. Recently, the NSW Position paper on Defence identified the following projects having possible significance to the Hunter region:

- Air Warfare Destroyer Sonar Maintenance and Support
- SEA 1000 Future Submarine
- SEA 5000 Future Surface Combatant (FFG replacement)
- Air Warfare Destroyer Combat System support and sustainment
- LHD Systems support and sustainment
- SEA 1000 Future Submarine and SEA 5000 Future Surface Combatant Combat Management and Communications
- Further upgrades to radars on current RAN fleet
- SEA 5000 Future Surface Combatant radar
- Army small arms weapons fleet maintenance
- LAND 125 Soldier Modernisation Programme

OVERVIEW

- RAN fleet maintenance and sustainment, including Air Warfare Destroyer and LHD
- SEA 1000 Future Submarine East coast basing
- SEA 5000 Future Surface Combatant support and sustainment
- Joint Strike Fighter (JSF) vertical tails and other JSF composite manufacturing
- C130J composites ongoing production opportunities
- Future RAN guided weapons maintenance and support
- Future RAAF guided weapons maintenance and support
- Possible 4th AWD block construction
- SEA 5000 Future Surface Combatant shipbuild
- SEA 1180 Offshore Combatant Vessel shipbuild
- Further AEW&C support and upgrade opportunities
- AIR 7000 Future Maritime Patrol systems maintenance, support and upgrade
- Future Autonomous Unmanned Vehicles (AUV) maintenance support and upgrade
- Future air combat aircraft maintenance, support and upgrade at Williamtown
- F18 Sustainment
- JSF Sustainment
- Maintenance, support and upgrade of RAAF Full Flight Mission Simulators
- Future ADF simulation and operational evaluation capabilities
- Future Navy Simulation Programme
- JSF Production
- Patrol Boat Replacement (Armidale and Pacific)
- Land 400 Vehicle Replacement
- Land 121 Phase 3 and 4
- Air 8000 Caribou Replacement C-27J
- Air 5405 Mobile Regional Operations Centre Replacement
- Air 5431 Air Traffic Control and Management System
- Air Traffic Control Projects and Sustainment

This extensive list of proposed contracts with an identified opportunity for the Hunter region indicates a strong need for local Defence Industry companies to prepare for the subsequent development and sustainment work. The ME Program provides a competitive advantage to the Australian Defence Industry who can ensure their local region is identifying and developing the talented individuals required for such work.

Program Structure

The ME Program structure has been designed around the need to meet and exceed contractual obligations, engage both industry and education stakeholders and create a low cost, flexible and effective model for program delivery with a view to program expansion in the future.

GOVERNANCE

On 1 July 2009, 14 Regional Development Australia (RDA) Committees were created in NSW after the State Government's Regional Development Boards and the Commonwealth's Area Consultative Committees were wound-up.

RDAs in NSW are non-profit, community-based organisations that are incorporated under the Associations Incorporation Act, 1984. Across Australia, there are 55 RDA committees which operate under contracts with the NSW and Federal Governments.

RDAs have linkages to all three tiers of government; but are not actually part of government. RDAs provide objective, well founded and non-political advice to Ministers and government agencies on regional needs and priorities including on emerging issues. The single and strategic narrative provided by RDAs is in relation to infrastructure, education and training, health, housing, job creation, opportunities for investment and economic growth as well as a broader range of regional issues.

RDA Committee Members are appointed jointly by the Commonwealth and State Ministers with responsibility for regional development. Members of the RDA Hunter Committee are drawn from a variety of sources including local government, business, community groups and leaders within institutions such as universities and TAFE. This RDA Committee of up to twelve members brings a range of skills, qualifications, local knowledge, local networks and experiences to their role as a "Board of Directors". RDA Hunter employs a small team of professional staff, headed by a CEO.

Government operational funding contracts require RDA Hunter to produce and regularly update a Regional Plan that reflects the region's priorities within the context of State and Commonwealth government policies. The Hunter Regional Plan is based on consultation, analysis of an extensive body of data, regional knowledge and input from local governments, businesses and community groups. The Defence Industry is a key sector championed by RDA Hunter as having significant benefit for the region into the future.

The emphasis for Regional Development Australia is on:

- Economic growth and productivity improvements to boost regions;
- A sharper focus in planning long-term regional economic development;

PROGRAM STRUCTURE

- Gaining consensus from a broad base of regional stakeholders on regional needs and priorities;
- Delivering government programs and projects for the benefit of the region; and,
- Advising governments on regional projects that are backed by cost benefit analysis to optimise economic outcomes for public and private investment.

Regional Development Australia – Hunter operates the ME Program under its funding agreement with the Defence Material Organisation. The ME Program Manager, an employee of Regional Development Australia – Hunter manages these contractual requirements of the program and where necessary obtains advice regarding program implementation from the ME Program Advisory Committee.

*Refer to Appendix B: Governance

ME ADVISORY COMMITTEE

The role of the ME Program Advisory Committee is to act as a consultative committee, focusing on the implementation and strategic aspects of the Program. The Executive Committee provides the ME Program Manager with advice on how best to achieve the objectives of the ME program strategy. The Advisory Committee is also tasked to pursue opportunities to strengthen the ME Program through the provision of relevant information, communication about the Program through their respective organisations and advocacy where required.

Membership of the Stakeholder Advisory Committee is comprised of representatives (at CEO or Regional Director/Manager Level) from the following organisations:

- 1. RDA-Hunter (Chair, CEO and ME Program Manager)
- 2. Defence Materiel Organisation
- 3. Enterprise(s) involved in the ME Program
- 4. School Educational Representatives
- 5. Hunter TAFE
- 6. University of Newcastle
- 7. Australian Industry Group

DELIVERY

Whilst the contractual obligations of the Funding Agreement provide clear guidelines as to the program goals and requirements it is the method of delivery that ensures continued community support and successful implementation of continuous improvement strategies. The delivery mechanism centres on

PROGRAM STRUCTURE

establishing value for each partner in the program. Industry partners (outlined in Appendix C: Industry Partners) are identified by establishing their corporations needs which may consist of:

- Community contribution goals
- Human resources outcomes
- A desire to identify in the Defence Industry space
- A goal to improve the growth prospects of suppliers and the industry as a whole
- A desire to advance a particular profession, particularly an engineering field
- An avenue for staff to engage in professional development opportunities

Likewise schools will participate in the program for a variety of reasons:

- Securing employment outcomes for students
- Improving educational performance
- Exploring new technologies and teaching pedagogies
- Gaining a recruitment advantage over other schools
- Highlight their partnership with a prestigious employer to the community

Whilst these school goals may differ from their industry partners' goals the beneficial outcomes remain for students and the defence industry over the long term. The ME Program Manager role is to identify potential beneficial partnerships and provide resolution to any issues as they may arise. Through the provision of consistent and clear program goals and the development of productive relationships with stakeholders the vast majority of all partnerships and interactions have remained positive and highly productive for both parties.

The ME Program Manager role also includes the appropriate selection and testing of the activities conducted under the program in order to establish the most beneficial and cost effective activities in accordance with advice from the Defence Materiel Organisation and the ME Program Advisory Committee . The ME Program Manager is assisted by the Communications Coordinator to achieve the Communications Plan as well as managing key events and school/industry interaction activities. Where appropriate the ME Program Manager is assisted by RDA Hunter's Communications Manager, Policy and Research Advisor, Financial Advisor, Personal Assistant to the CEO and the Chief Executive Officer.

Program Activities

The volume and quality of school activities have increased as school partner numbers have increased and further engagement of the local Defence Industry has been secured. Schools are given a large deal of autonomy to select activities that will meet program objectives which allows for tailored solutions that fit to industry and school goals, greater engagement from school leaders and reduced costs for RDA Hunter through the diminished requirement for additional staff and resources.

LIVING TOOLKIT

The Living Toolkit project embodies the span of works completed during the program that attempt to contextualise curriculum content with industry relevant examples. The scope and nature of the toolkit has been designed to change over time as new technologies and fresh ideas emerge. The entire catalogue of Living Toolkit resources (*Appendix D: Living Toolkit*) is now an extensive database utilised in different ways by different schools and teachers. The expansion of Living Toolkit resources has coincided with the emergence of Problem Based Learning and Flipped Classroom teaching strategies which harmonise well with the developed resources giving teachers access to digital media that is readily utilised by students using electronic devices.

The initial development of the Toolkit was achieved through the use of a 'teachers in industry' concept whereby teachers spend time embedded in manufacturing firms in order to gain increased understanding about how their curriculum content is used in industry. Teachers were then tasked with creating teaching materials that incorporate the industry content with the Board of Studies Curriculum requirements. In order to extend the benefit of these documents teachers were then tasked with producing teaching resources and instructing other teachers on their use. Documents and video content are housed on the ME program website for use by all partner schools.



Photo 2: Screenshot of Living Toolkit item "ME Program Lego Robotics Video – Graphing"

PROGRAM ACTIVITIES

Robyn Horsley, Director of Teaching and Learning (Innovation) at St Phillips High School Waratah made the following comment about the Living Toolkit resources:

"The Living Toolkit resources provide me with a unique method in explaining course content in a way that has direct relevance to the student's world. It is profoundly powerful to be able to educate students with real-world examples of content that are created in partnership with local companies. It would be fantastic to see more of these resources created and presented as video content into the future."

*See Appendix D: Living Toolkit for a comprehensive list of resources created and collated under the Program

F1 IN SCHOOLS

F1 in Schools is a comprehensive program designed to engage young people in all aspects of the design, development, implementation, marketing and management of an engineering project. Since RDA Hunter became involved the F1 in schools program in the Hunter it has grown from just four participating schools to over twelve schools with increased student numbers in each. RDA Hunter's focus is on increasing the level of teacher training in 3D Design as well as the purchase of CNC machining and other manufacturing equipment. In addition RDA Hunter's focus on aligning schools with an industry partner has increased the level of manufacturer engagement which in turn has increased the support to schools through technical expertise and financial contributions. In 2014 the full benefits of this support became truly evident as two teams excelled at the Regional and State Level of competition propelling them to the National round for the first time in the Hunter's history. Supersonic Speed, the Merewether High School team placed third and are currently exploring a partnership option with another NSW school to compete in the International Finals in Dubai.

ROBOTICS

Early in the development of the ME strategy robotics were identified as a useful mechanism to engage students and create a preparedness for emerging skill needs. Initially the Lego Mindstorms NXT kits proved to be the most effective resource available due to their reasonably low cost, ruggedness in the school environment, user friendly programming language and access to existing training materials. The Lego Mindstorms kits also allowed students to enter Regional, National and International competitions.

The level of interest displayed by schools was high and proved to be a popular technology pathway for schools entering the program. In addition to the purchase of Mindstorms kits RDA Hunter provided funding to create teaching resources in video and written format as well as support for the Regional competition.

PROGRAM ACTIVITIES

Further robotics projects have grown from this initial strategy and now all iSTEM schools use Arduino robotic arms systems to provide more advanced levels of training for advanced students.

THE ME MACHINE

The "ME Machine" is a low cost physical simulation of three advanced manufacturing stages;

- 1) 3D Design and print
- 2) PLC control of parts transport sensors, pneumatic and electromagnetic actuators, PLC programming
- 3) Robotic arms for part detection, part manipulation and placement

Combined with a pioneering Problem Based Learning teaching system the ME machine creates fundamental shifts in student awareness of the relevance of STEM studies to the emerging manufacturing sector. The project is highly sought after amongst ME schools and many schools are working to implement the system within their schools.

ISTEM

The integrated Science, Technology, Engineering and Mathematics program is a Year 9 and 10 subject endorsed by the Board of Studies and developed in partnership with Defence Industry. RDA Hunter developed iSTEM in partnership with schools and industry as a response to the growing concern about the disconnected nature of STEM subjects. The iSTEM subject integrates the key elements of Science, Technology, Engineering and Mathematics to create a subject that allows for collaboration between teachers and enhances students' awareness and retention of key subject matter.

Seven schools have run the program in in 2014 with many more expected to offer the subject in 2015.

"I just wanted to let you know that Hayden Moxey, an iSTEM student at Maitland Grossmann, achieved 3rd in the state for Engineering Studies in 2013. This is a great follow up from Benjamin Fraser who achieved second in the state in 2012. Ben was involved in the early stages of the ME program and Hayden has been involved in our iSTEM trial. The results of this outstanding program are starting to come through." Scott Sleap, Head Teacher Technical and Applied Science, Maitland Grossmann High School

PROGRAM ACTIVITIES

AWARDS

Awards are both entered and offered by RDA Hunter as a means to promote the goals of the program and position the ME Program as a leader in its field.

Awards entered and won by the ME Program include:

- Hunter Manufacturing Awards Manufacturing Education category 2011
- Hunter manufacturing Awards Manufacturing education category 2012
- Australian Business Awards 2013 Award for Community Contribution

Awards sponsored by the program:

- Hunter Manufacturing Awards Manufacturing Education 2013
- Hunter Manufacturing Awards Manufacturing Education 2014
- Hunter TAFE Alumni Awards 2013 Emerging Talent Award
- Hunter TAFE Alumni Awards 2014
- Numerous gifted and talented awards at High Schools



Photo 3: David Powers, Greeneye Industrial Design receiving the TAFE Emerging Talent Award from ME Program Manager, Ashley Cox

Communications Report

Marketing and communications play a key role in the program as it provides a startegic tool for engaging young people as well as providing exposure for the program, its industry partners and the Defence Materiel Organisation. The communications strategy allows for the presentation of key elements in a variety of mediums and allows for the manipulation of strategies in order to maximise the effect. A variety of media have been utilised since the inception of the program including:

- Print Media
- Radio
- Website
- Social Media
- Television
- Sponsorship

PRINT MEDIA

Print media was initially utilised as a medium to engage parents and students. The efficacy of this technique was assessed on its ability to encourage attendance at events and traffic to the ME Program website (www.meprogram.com.au). From late 2012 onwards the utilisation of print media was ceased as emerging media trends, especially online media was found to be more cost effective at engaging the target audience.



Photo 3: Example of T42 advert run in late 2011 in the Newcastle Herald.

RADIO

Whilst no commercial time on radio was purchased through the ME Program, regular appearances on ABC Local Radio 1233 and mentions on local commercial stations have occurred throughout the program.

WEBSITE

In 2010 an initial website was created to promote the program locally. This site generated little traffic and did not provide an informative and attractive site for young people to gain information about the program and its industry partners. In 2012, the website was redesigned to provide an engaging and attractive site that would provide useful content for young people and promote industry partners. The site was optimised for popular search engines and its effectiveness in achieving first page ranking in keyword areas is reviewed on a monthly basis.



Photo 4: Screen shot of the ME Program home page: <u>www.meprogram.com.au</u>

The website changes proved successful generating a significant increase in site visits. Encouragingly site visits largely stem from Australian domains and usually occur mid-week, a trend which suggests that schools are using the website for careers classes and that students were finding the site from these classes



Figure 3: The number of site visits per month has steadily increased since the site began in early 2012.

As of 30th June 2014 the website has achieved 16,789 unique sessions averaging 1 minute 43 seconds per visit. On average visitors will explore approximately 3 pages per session with the "industry partner" and "careers sections" achieving the highest traffic. The search ranking has improved to the point where 4 out of our selected 10 keywords rank in the top 10 in Australia placing the ME Program website on the first page of engine searches. RDA Hunter intends to further develop its keyword list and rank in the top 10 for all keywords.

The website serves not only to engage young people but as a way to offer value to industry partners for their membership within the program. As an example in 2012 after promoting Ampcontrol's apprenticeship intake the **ME Program website ranked first in Australia for "2012 apprenticeship intake"**. Subsequently Ampcontrol received over 1200 applications for their apprenticeships, doubling the applications from the previous year.

SOCIAL MEDIA

The ME Program's Social Media campaign is a significant part of the strategy to engage and inform young people. Social media campaigns have proven especially effective as they have the ability to provide targeted communications at significantly lower cost than other mediums. RDA Hunter has embarked upon two major strategies to engage young people. Facebook has proven to be a reliable and effective tool for meeting the ME Program strategy enabling the posting of ME Program events, good news stories and the cross sharing of related science and mathematics topics.



Figure 4: Graph showing increase in number of students that "like" the ME Program Facebook page between early 2013 and Mid 2014.

A key element of the Facebook campaign is that it allows for the targeting of age groups and regions. Data collected during the campaign reveals that the majority of Facebook followers are within the target age group and within Australia.



Figure 5: Distribution of ME Program Facebook fans according to age and gender

In addition to Facebook advertising the **ME Program YouTube channel** has also proven effective with over 74,000 views of ME Program Industry videos. These videos continue to attract visitor's overtime and support further engagement with the ME Program website and Facebook page. The ME Program YouTube channel also hosts many of the Living Toolkit videos that are used to support students and teachers working in the classroom setting.

The channel has been incredibly successful in achieving key goals. A recent request from the Southern Region Education Board, **Atlanta, USA** for permission to utilise video content for their STEM course highlights that the quality of course content is achieving world best practice in STEM education.



Figure 6: "What is an electrical engineer?" video on Youtube has been particularly successful and now approaches 60,000 views since its launch in mid-2012

TELEVISION

Whilst no Television advertising has been conducted the ME Program has appeared as local and national news items during the contract period. Whilst a presence in television media can provide a wide audience the ability of RDA-Hunter to manage the promotion of key stakeholders is limited. As an example an ABC National news item airing on the 22nd May 2014 required a large commitment of time and effort to coordinate however any mention of key stakeholders was omitted in the editing of the story.

*For further information see Appendix : Communications Plans 2011 - 2014



Photo 5: Students from St Phillips High School tour Defence Shipping facility Forgacs during a partnership exercise in 2012

OUTCOMES

Outcomes

A key goal of the program since its inception is that it produce measurable and consistent outcomes and demonstrates value for its expenditure. Regional Development Australia – Hunter has demonstrated an ability to produce exceptional outcomes when considered against State and National benchmarks and a continued ability to refine the effectiveness of the program against fixed budgets.

In order to establish genuine achievement towards its goals a range of research methodologies were trialled. Initial survey costs were built into the program structure and at the outset the Hunter Valley Research Foundation was engaged to survey students in 2011. The initial survey covering over 800 students provided initial baseload data however because of inconsistencies in school management of the online survey little information was garnered about shifts in student subject selection or perception of the industry. The ME Program Advisory committee elected to discontinue the online survey and the collection and collation of data was refined and brought in-house.

*2011 baseload data and survey responses are included in Appendix F: Program Outcomes

Regional Development Australia – Hunter selected its primary focus of creating shifts in subject selection for the Higher School Certificate in Year 11. This strategy was chosen due to its:

- cost effectiveness and ease of access
- minimisation of confidentiality risk to schools
- ability to be compared to NSW averages
- Industry feedback indicating preferences for subject selection as a priority

Key subject selection areas were identified by industry partners as being of key importance to the technical abilities of future staff. Key subjects measured included:

- Physics
- Engineering Studies
- Metals and Engineering Certificate III
- Mathematics

PHYSICS

Physics as a HSC subject has been identified by industry partners and local tertiary institutions as a keystone subject for students wishing to gain employment in engineering and related occupations. Despite the Hunter employing large numbers of engineers across many industries the number of ME Students studying HSC level Physics was well below the NSW average at just 12%. Without interventions to arrest

this knowledge gap it is highly likely the decline in Physics uptake for HSC would have matched that of the NSW trend. By 2014 17% of the ME Year cohort have selected Physics. This is a strong indication of the change in student perceptions of the subject and the ability of the program to establish relevance to the cohort.



Figure 7: Physics enrolment in the HSC, ME Program schools vs NSW High School averages

Further evaluation of Physics data also reveals that once students in the ME Program have selected the subject they are more likely than the State average to continue in the subject to year 12. The dropout rate from Physics between Year 11 and 12 in the state is approximately 13% whilst the ME Program Schools currently sits at 6%.

ENGINEERING STUDIES

The syllabus of the HSC Engineering Studies course provides a pathway for teachers to embed content that is directly relevant to the Defence Industry. Many of the ME Program technologies supplied to schools can be directly implemented in HSC Engineering Studies content. Emerging technologies such as 3D Printing, CNC Machining, Unmanned Aerial Vehicles, Robotics and Embedded Systems purchased through the programs funding provide real insight into the purpose and relevance of this subject. As a result Engineering Studies numbers continue to amass against the NSW trend of stagnancy in this area. ME students now select the subject at three times the level of NSW averages.



Figure 8: Engineering Studies enrolment in the HSC, ME Program schools vs NSW High School averages

MATHEMATICS

Mathematics selection in the HSC is a difficult area to test for clear outcomes. According the NSW Board of Studies only 1% of NSW HSC students elect to do no mathematics at all. Despite this, industry reports of a decline in mathematical reasoning amongst school graduates remains a concern at the National and State level. RDA Hunter has worked with schools to diagnose the key issues involved in improving mathematical reasoning and ensuring that students elect more challenging levels of mathematics. A variety of reasons compound to negate efforts to affect improvement in this area:

- Myths amongst teachers and career advisors regarding the scaling of mathematics results in the HSC
- The complexity in measuring results accurately amongst changes brought about by the National Curriculum
- The difficulty in attracting students into Mathematics teaching at the High school level ultimately resulting in limited human resources within schools for Toolkit resource development
- Limited mathematics teacher numbers within schools resulting in the retraining of teachers in other more popular disciplines leading to a subsequent decline in teaching standards and teacher engagement in the field

Despite these barriers there appears to be an emerging trend of resistance locally to the continued decline of Extension 1 mathematics. A subject regarded by universities as a necessity for the successful completion of first year engineering subjects.



Figure 9: Mathematics Extension 1 enrolment in the HSC, ME Program schools vs NSW High School averages

The ME Program Advisory Committee believes, having identified the barriers to advanced mathematics subject growth that a successful strategy can be implemented to grow Extension 1 and 2 Mathematics uptake into the future. Key elements of this strategy include:

- The development of industry based online tutorial content for use in classroom activities
- A specific program to encourage female students into the courses
- Using industry partners to create resources that highlight the importance of these subjects in industry
- The further utilisation of role models to support mathematics subject selection

OUTCOMES

METALS AND ENGINEERING

The Certificate II in Metals and Engineering provides students with the fundamental building blocks required to attain competency in most trade based occupations currently relevant to the Defence industry. Despite already outperforming state averages in this area the ME program has further driven the selection of this vocational subject in partner schools. An outcome such as this in a vocational field is evident of the program's success in creating outcomes relevant to all industry partners.



Figure 10: Metals and Engineering Certificate II enrolment in the HSC, ME Program schools vs NSW High School averages

ISTEM - INTEGRATED SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS

The iSTEM subject was first introduced as a formal Stage 5 subject (Years 9 and 10) in 2013 at Maitland Grossmann High School. Uptake of the subject by schools led to 9 classes running 2014 across 7 schools. Initial estimates of uptake for 2015 suggest a minimum of 15 schools will run the program within the region and that other schools with NSW but outside the region will begin to run the course.

This strategy creates a high degree of cost efficiency by allowing for existing teaching allocation hours to account for ME Program goals. Its expansion across State and National school systems will further support the cost effectiveness of this strategy.

*For comprehensive details of program results see Appendix F: Program outcomes 2011 - 2014

BENEFITS TO THE DMO

Benefits to the DMO

"Varley Group values the Advanced Manufacturing Industry Schools Pathway Program. It has added to our workforce capabilities, its continuation is imperative to the Hunter's future Defence workforce" Jeff Phillips, Chief Executive Officer of Varley

According to the Australian Industry Capability program the Defence Materiel Organisation is committed to providing opportunities for Australian companies to compete on their merits for Defence work within Australia and overseas on a value for money basis. The ME Program, by ensuring a stable supply of potential graduates ensures that local industry is confident in its ability to attract technically capable graduates and that the feedback they supply on potential regional skill needs to the program will affect fundamental change in educational mechanisms.

The anticipated increase in technical complexity of future defence work will create an increase in demand for workforce entrants with technical skills and experience. As the ME Program engages a future workforce skilled in emerging technologies it remains an effective strategy for the Defence Materiel Organisation to continue to support the Australian Defence Industry via the program as it competes globally. All of the ME Program Industry partners have identified the need to foster a regional workforce that is technologically aware and able to adapt to emerging industries. BAE Systems, a five year partner in the ME Program have remained supportive and included the program in their business plan.

"From the perspective of BAE Systems the ME Program has grown to become a key asset to our company and the Hunter region. The ME Program has the ability to increase our profile with young people and highlight the benefits of the Defence Industry to the region. It has demonstrated its ability to gain traction in improving High School STEM uptake where so many other programs have failed. As

BAE Systems plans for its future skill needs the ability of a region to prepare for emerging technologies and industries provides a powerful incentive for us to grow and expand our workforce in the region. BAE Systems would like to see the program continue and are committed to our partnership with three local high schools."

John Quaife AM, General Manager Aviation Solutions, BAE Systems Australia

The NSW Position Paper on Defence elaborates further in the importance of providing a skills base that is Defence ready.

"For Defence, critical skills shortages exist in the areas of Project Management, ICT Integration, software programmers and most engineering disciplines. As a result of its comprehensive educational and vocational sectors, NSW is well positioned to assist Defence to develop these additional skills. Importantly, NSW is much better placed than the other States to provide the required higher end tertiary skills that will be critical to the future design, acquisition and sustainment of complex defence systems and platforms." NSW Position Paper on Defence – 2013 pg. 11

Recommendations

LIVING TOOLKIT

The program has demonstrated an ability to create genuine outcomes and is emerging as a powerful force in creating a new learning culture within schools. The emergence of the Flipped Classroom and Problem Based Learning pedagogies is intimately connected with the desired goals of the program. These new learning techniques promise to revolutionise High School education and there is a very real opportunity for the program to harness these developments in a way that will secure a highly accomplished and agile workforce for this region and other defence regions. It is recommended that the commitment to contextualised learning at the High school level be continued.

Recommendation: That DMO continue to fund the development of Living Toolkit resources as a cost effective mechanism for engaging young people in Future Defence projects.

DEFENCE INDUSTRY PARTNERSHIPS

The program partnerships developed between Industry and Schools have reached a critical phase where many young people that began in the ME Program in Year 8 will graduate High School in 2015 and 2016, making decisions to either enter industry or explore tertiary pathways important to the Defence sector. Continued contact with their industry partner at this crucial period will ensure that the full benefits of the program to the Defence Industry can be realised. Expansion of the program into other regions and emerging technology sectors will further enhance the productivity of the program. Many Prime Defence contractors in the program have already expressed interest in expanding their activities to other key Defence regions.

Recommendation: That DMO continue to fund Industry Partnership continuation and expansion in order maximize industry benefit

VEHICLE FOR EXPANSION

The ability of the program to remain unencumbered by excessive educational bureaucracies is a key element of the program that should remain in any further iterations of the program. Not only does a flexible and evidence based approach to funding models provide maximum value for the Defence Materiel Organisation it also allows for the specialisation of skillsets according to regional, school and industry need.

The use of Regional Development Australia – Hunter as a partner in program continuation and expansion nationally would provide:

- Regional ownership and program development based on community identified need and opportunity
- A robust governance framework that is both transparent and auditable
- A shared goal to foster economic growth and nurture regional economic development
- A proven track record in facilitating productive education/industry partnerships
- Previous experience in resource management to achieve financial efficiency
- A high level of communication within the network
- Independence from secular and non-secular school systems to ensure industry needs are prioritised
- An ability to overcome local government and state boundaries as barriers to program growth and success
- A high value mechanism of project development that becomes more efficient as it is expanded

Recommendation: Explore the use of Regional Development Australia – Hunter as a vehicle to expand the scope of the program into identified Defence Industry regions of significance.

TARGETING FEMALE STUDENTS

With forecasted skill gaps across all industries involving engineering the capacity to engage talented students into engineering pathways for the Defence Industry becomes increasingly critical. When assessing the forces leading to the uptake of careers the Programme for International Student Assessment (PISA) suggests that female Australian students are becoming increasingly disengaged from mathematics.

Notably the PISA results revealed:

- Sixty per cent of Australian girls believed they were not good at solving mathematics problems compared to 44 per cent of boys, while 64 per cent of girls believed that sometimes course material is too hard compared to 50 per cent of boys.
- Approximately one-third of Australian girls reported that they did not think that mathematics was important for later study, compared to one-fifth of boys.
- Australian girls were less likely than boys to report feeling capable of successfully completing specific maths problems, and were more likely to attribute failure to external factors or chance and less likely to attribute it to their own efforts.

• Australian girls had higher levels of mathematics anxiety – the worry and tension felt when confronted with mathematical tasks – than boys, with girls reporting levels of anxiety higher than the OECD average, and boys reporting levels lower than the OECD average.

Whilst disengagement in mathematics and sciences by High School girls is a disturbing trend the results of the ME Program to date highlights a potential recruitment pool that could be harnessed to propel the Defence Industry forward if successfully implemented. That is, using the methodologies of the ME Program to resolve the disengagement that occurs in traditional school techniques and replacing them with contextualised teaching strategies specifically aimed at female students.

Recommendation: That through RDA Hunter funding the Defence Materiel Organisation implements a resolution to female student disengagement in mathematics as a strategy to significantly enhance the uptake of engineering and advanced manufacturing careers in Defence Industry regions.



Photo 6: Catholic School Office Maitland-Newcastle signing a Memorandum of Understanding with Thales Australia in 2011.

APPENDICES

Appendices

Appendix A-G Will be provided in a separate document and in softcopy to limit storage and download restrictions.

Appendix A: School PartnersAppendix B: GovernanceAppendix C: Industry PartnersAppendix D: Living Toolkit ResourcesAppendix E: Communications Plan 2011 – 2014Appendix F: Program Outcomes 2011 -20 14Appendix G: Financial Management

Contact Information

This report was prepared by:

Ashley Cox

ME Program Manager

Regional Development Australia – Hunter

Phone: (02) 4908 7303

Email: <u>ashley.cox@rdahunter.org.au</u>