Get Set for Success: Using online self-assessments to motivate first year engineering students to engage in and manage their learning

Final Report 2013

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EngCAT website: http://engcat.usq.edu.au

The website provides to access to the EngCAT self-tests and other materials

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List of acronyms used

EngCAT	Engineering Career Appraisal Tool
OLT	Office for Learning and Teaching
UNE	University of New England
UoN	The University of Newcastle
UQ	The University of Queensland
USQ	University of Southern Queensland
UTS	University of Technology, Sydney

Executive summary

The *Get Set for Success: Using online self-assessments to motivate first year engineering students to engage in and manage their learning* project aimed to address the looming skills shortage in the Australian engineering profession by better identifying the key factors underpinning student success in transitioning to engineering studies. This information could then be used to develop tools and strategies to:

- encourage more students to consider careers in engineering;
- help engineering students transition to university studies; and
- retain more engineering students through to graduation.

The two-year project built on King (2008) and Godfrey and King's (2011) Australian and Learning Teaching Council (ALTC) projects which aimed at developing strategies to build student numbers in engineering programs and improve progression and graduation rates. This project was designed to help students make an informed career choice and successfully transition to university life. It focused on better understanding the traits and skill sets that typically are suited to engineering studies by identifying key factors that predict success in the first year program.

The members of the project team came from five universities that cover the spectrum of Australian universities and engineering programs. The team has compared and contrasted student self-assessment data against academic performance, using both quantitative and qualitative research methods. Cognitive and non-cognitive abilities were measured using online self-assessment and focus groups at each partner university.

The project team developed the Get Set for Success Quiz in 2011 and deployed it in the engineering faculties of the five partner universities at the start of 2012. More than 800 first year engineering students undertook the test in semester 1, 2012, investigating both cognitive and non-cognitive factors that predicted success in first year engineering. The key findings were that while mathematics and other relevant subject-related cognitive skills were the most important predictors of academic success, non-cognitive factors such as approaches to learning, motivation and interest in engineering, were also significant. The quiz was refined and redeployed in semester 1, 2013. Data from the 2012 and 2013 studies has informed the development of an online engineering career appraisal tool (EngCAT) for students considering a career in engineering.

Each student who completed the quiz in 2012 and 2013 received personalised feedback (see Appendix A) and a list of the resources at their university they could use to review prior learning and prepare for their engineering studies. This approach helped to motivate first year engineering students to engage in and manage their learning.

Outcomes and recommendations

The Get Set for Success Quiz enabled the project to identify the key predictors of academic success in engineering programs. As expected, cognitive skills are important, however, non-technical skills – personality types, learning approaches, and interest and motivation in engineering – also play a key role. The project team developed the Interest and Motivation

for Studying Engineering (IMSE) scale to measure these non-cognitive factors. This self-test questionnaire is available via the EngCAT website, http://engcat.usq.edu.au.

EngCAT is an online educational resource that enables prospective engineering students to self-test their interest and motivation in engineering and make an informed choice about their career path. The EngCAT website can be used for careers advice – helping prospective students better understand their individual learning approaches, how they work in teams, and whether they have the skills and interest to pursue a career in engineering. This enhanced self-awareness will enable students to seek support where needed and better manage their learning to successfully progress through their program.

EngCAT is designed to help the engineering industry attract students who have the required skill sets but may not otherwise have considered a career in engineering. Thus, deploying EngCAT on the Engineers Australia website, through high school career adviser networks, and on government career websites, should increase the pool of eligible candidates seeking a career in engineering. This will, in turn, help to address the skills shortages many sectors of the engineering industry are currently experiencing.

Deliverables

Key deliverables of the *Get Set for Success* project can be considered in three broad categories.

- The online Get Set for Success Quiz enabled first-year students across the five partner universities to self-test their cognitive abilities and non-technical skills, and use their individual feedback to review and build their knowledge and skills to experience success in their engineering studies. It is therefore appropriate to list this tool as an additional outcome the project has delivered. Colleagues will continue to refine this quiz and roll it out more broadly at other institutions beyond the life of this project.
- A key deliverable is the prototype Engineering Career Appraisal Tool (EngCAT) - the online educational resource that enables prospective engineering students to self-test their interest and motivation for studying engineering. The EngCAT self-tests provide automatic feedback that helps students develop an individual study plan to address any gaps in knowledge and skills and refine their career plan to become an engineer.
- Disseminating project findings through academic and scholarly publications, workshops, and conference presentations created a community of engaged stakeholders in the engineering higher education and careers sectors. This included presenting key findings at the annual Australasian Association for Engineering Education (AAEE) conferences and other relevant learning and teaching conferences plus presentations at careers, vocational education and training (VET) and science, technology, engineering and mathematics (STEM) professional development workshops. A copy of the final report will also be provided to the Australian Council of Engineering Deans (ACED).

The outcomes and deliverables of the project can be found in a range of publications as well as on the refined EngCAT website.

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Chapter 1: Introduction

This project was designed to achieve the following outcomes:

- Identify the key capabilities, knowledge, traits and skill sets that typically are suited to engineering studies.
- Present strategies for attracting, motivating, and retaining students suited to engineering.
- Develop a prototype online self-assessment and educational tool: the Engineering Career Appraisal Tool (EngCAT).

In targeting these outcomes, the team had to develop an online tool to measure the cognitive and non-cognitive skills and traits of first year engineering students, and to determine the correlation between those skills and traits and academic success.

This online Get Set for Success Quiz (see Chapter 2) effectively enabled students to self-test their skills and use their individual feedback (see Appendices A & B) to review and build their knowledge and skills before beginning university studies. It is therefore appropriate to list this online self-assessment tool as an additional outcome delivered by this project.

Approach and Methodology

This project involved collaboration between educators at the five participating universities, each with distinctive features of history, location, and student population:

- University of Southern Queensland (USQ) is a regional university with approximately 80% of its students studying part time via distance;
- The University of Queensland (UQ) is a Group of Eight university whose students are predominantly highly qualified school leavers who study full time, on campus;
- University of Technology, Sydney (UTS) is an Australian Technology Network university whose students study on campus, many in part time mode;
- The University of Newcastle (UoN) is part of the Innovative Research University group with more than half its students arriving via other higher education and TAFE pathways; and
- University of New England (UNE) is a regional university with a small engineering school, with most students entering directly from high school with industry funded cadetships/traineeships.

The diversity of the partner institutions helped this project address the needs of students across the spectrum of Australian universities and engineering programs.

All these universities had been facing first year attrition issues and dealing with them in varying ways depending on their specific context. For example:

- UQ and UoN only offer professional engineering degree programs;
- UTS offers engineering degree programs at the professional and engineering technology levels;
- USQ offers engineering degree programs at the professional, engineering technology, and associate engineering levels; and
- UNE only offers an engineering technology degree program.

The project team formed to work on the common goal of developing strategies to enhance enrolment, progression, and graduation rates in their engineering programs.

Literature Review: Factors Influencing Academic Success

The global expansion of numbers of students choosing to access further study and the opening of higher education to a wider demographic distribution have increased the numbers and diversity in the student population (Keenan, 2012). Flexible enrolment policies over the past decade or more have relaxed the academic entry standards that universities require. This focus on a more socially inclusive enrolment strategy has not been the only driver in opening more places and changing entry standards in higher education. Kavanagh, O'Moore, and Samuelowicz (2009) noted that changes in entry requirements for first year engineering at UQ had been made in response to a shortage of engineers in that state. As a result, student numbers in first year engineering at UQ had increased from 521 in 2005 to 970 in 2008.

While such policies empower and enable more students to enter tertiary programs, they create inherent risks. For example, Kavanagh et al. (2009) reported a decrease in student satisfaction and an increased attrition rate. At USQ, Dowling and Burton (2005) found that 60% of the students entering engineering programs with lower tertiary entrance scores than would previously have been permitted, were "at risk" of failing or dropping out by the end of their first year. Lower levels of prior maths study were also factors that placed students at risk. Dowling and Burton recommended raising the entry level requirements to reduce the numbers of students failing to complete their studies. Shepherd, McLennan, Kavanagh, and O'Moore (2011) expressed similar concerns about high attrition rates among students who had been allowed to enrol without the pre-requisite knowledge and skills.

Trotter and Roberts (2006) suggested that student attrition was related to their lack of readiness to embark upon tertiary studies. Academics in Britain have also identified a similar problem, reporting that students feel unprepared for studying disciplines such as physics and engineering (Grove, 2013). Grove, the Director of the National Higher Education Science, Technology, Engineering, and Maths (HE STEM) programme, noted that this lack of readiness still exists, despite the fact that the number of students completing higher level maths at high schools in Britain has increased since 2000, and that students are entering university with higher scores in maths.

Students may also arrive at university with varying – and often unrealistic - expectations of their tertiary experience (Keenan, 2012). Brinkworth, McCann, Matthews, and Nordstrom (2009) found that while 90% of the students they surveyed reported that they had expected university to be different from high school, many were over-optimistic in their expectations about the amount of feedback and lecturer contact they would have. Many students thought that lecturers would be available to provide individualised assistance such as ready and extensive consultation, and to read and provide feedback on assignment drafts (Crisp et al., 2009). McCann (2011) reported that 80% of new students expected lecturers to spend more time engaged in teaching than the recommended and actual amounts. Students said they relied heavily on easy access to their lecturers, but only 54% of students had such access. Brinkworth et al. (2009) also found that successful transition was due to non-

cognitive factors such as autonomy and the ability to adjust to the different learning circumstances encountered at university. Students need to adapt quickly to being self-directed learners.

Pitkethly and Prosser (2001) responded to the concern that most students who withdraw from tertiary studies do so because of transitional issues relating to mismatched or ill-formed goals or a sense of feeling isolated, rather than intellectual issues. They noted that causes for withdrawal should not be treated in a generalised way, as many issues were specific to the particular university and its culture and circumstances. They also noted that while withdrawals can have an adverse impact on both the individuals and the institutions, not all withdrawals are related to academic failure. Some students change institutions or leave for alternative careers or to move into employment. They found that the reasons changed as time progressed. At the time of their study, first year students at La Trobe University in Melbourne were most likely to make an early withdrawal from courses to change institutions or to enrol in different courses at the same university. This implies that students may have engaged in poor career decision-making processes before their enrolment, or that they had inadequate or unrealised expectations of their chosen courses. Withdrawals in the second semester were more likely because of personal issues or getting a job (Pitkethly & Prosser, 2001).

Another barrier to successful transition is that many students face financial pressures which force them to spend significant time working in part time jobs (Potter & Parkinson, 2010). A study conducted with students in a mid-western university in the USA (Kulm & Cramer, 2006) found that the higher the number of hours worked, the lower the students' academic performance. Kulm and Cramer (2006) found that the number of hours of employment was not related to attendance or reported study time, but was negatively related to GPA, suggesting that issues relating to engagement and preparation were the contributing factors. Thus, students' willingness to attempt to manage large study and employment workloads may also be an indication of their unrealistic expectation of what their university commitments might entail.

Lizzio (2006) described five senses as facilitating transition into first year:

- a sense of capability (being confident and cognitively prepared);
- a sense of connectedness (social integration into the university community);
- a sense of purpose (commitment to articulated goals);
- a sense of resourcefulness (knowing how to access support and facilities); and
- a sense of academic culture (knowing the norms and processes of the university environment).

Because many students enter tertiary studies other than directly from school, they may also lack self-efficacy in the academic setting. Wilson and Lizzio (2008) found variability in the extent to which students felt confident in their ability to negotiate their academic path and consequently to self-direct their learning. Providing support for students with low levels of confidence is an essential strategy for managing student retention. If their early experiences reduce their confidence (e.g., failing an assessment item or receiving harsh feedback), then their likelihood of dropping out increases. Proactive and targeted interventions are essential to keep these students on track and to help them feel they can persist with their studies

(Taylor & Lawrence, 2007; Wilson & Lizzio, 2008). Wilson (2009) called on those involved in tertiary education to see managing transition into first year as core business, and to take an integrated approach that would deal with the issue at a systems level. Wilson also noted the importance of engaging with students well before they arrive on campus, be that physically or virtually.

In exploring student withdrawal issues, Tinto (1987) outlined a number of principles which should apply to any retention strategies. First was that students should have, or be able to acquire, the skills they need to achieve academic success. Second was that interventions should be available early in the student experience. Tinto (1987, 1993, 1995) consistently claimed that focussing on helping students become effective learners made some issues of withdrawal disappear. Peel (1999) also set out a number of principles guiding efforts to address transition problems, first among these being the need for early identification and prediction of likely problems.

Lizzio and Wilson (2010) devised an intervention to facilitate positive transition into first year studies. Their goal was to develop a sense of purpose in first year students and to do that they employed an online tool to establish a learning contract, focusing on the following factors:

- Intellectual inquiry: I am very curious about the ideas in my degree;
- Social: I want to take advantage of the social and recreational possibilities at university;
- Academic achievement: My main intention at university is to achieve academic success;
- Vocational: My main aim in doing this degree is to be well-trained for my chosen career or job;
- Personal development: I am looking for personal enrichment and development from my university studies; and
- Community: My main aim in doing this degree is to be able to make a positive difference to society (Beaty, Gibbs, & Morgan, 1997, as cited in Lizzio & Wilson, 2010, p. 1).

Lizzio and Wilson (2010) noted that students used the tool to self-reflect, which impacted on their self-awareness. This self-reflection process was also important for legitimating and affirming their career choice. Lizzio and Wilson observed that students' sense of purpose was malleable and something that their experiences continued to develop and shape. Griffith University (Wilson & Lizzio, 2008), and University of the Sunshine Coast have used this intervention to good effect with students who had failed an early assessment item (Potter & Parkinson, 2010). The underlying strategy was to help students reflect on why they failed and how they might recover. It was found that students who had participated in the program at both institutions were better at regulating and managing their learning behaviours, were better connected with their tutors, and were therefore more able to ask for help when necessary.

Examples of online tests that have been used to help students self-assess their readiness to undertake studies in engineering are the Ready for First Year Quiz (RFYQ) at The University of Auckland and the Preparing for First Year (PFFY) quiz at The University of Queensland

(Shepherd et al., 2011). Both featured multiple choice quiz items based on the knowledge and skills expected to have been learned in high school. The questions were mainly drawn from high school mathematics subjects, with some from chemistry and physics. Both tests included response options of "can't remember how to do it" and "never seen it before", to discourage students from uninformed guessing and to help pinpoint areas where concepts were genuinely unknown.

Feedback was immediate and online, and information about how to address any identified knowledge gaps was either provided online (PFFY) or in a generic email (RFYQ). The PFFY had the additional feature of plotting the students' individual responses against course requirements, giving students direct and relevant feedback about their cognitive strengths and weaknesses. Having individual feedback and these specific and explicit links can increase motivation for learning by showing the relevance of the various skills being tested (Lizzio & Wilson, 2004b). The British HE STEM project also includes use of an online transition quiz (http://www.stem-transition.ac.uk/) which students can complete to identify skills gaps and weaknesses. Initially the data were used to provide cohort information to teaching staff, but the latest phase has been adapted to include individual feedback to students.

Ongoing studies of key factors predicting engineering students' academic success conducted by Burton and Dowling (2005, 2009) supported the well-established finding that the major predictor was previous academic success, attributed to intellectual ability. However, research indicates that more than half the variance in student outcomes relates to factors other than cognitive abilities (e. g., O'Connor & Paunonen, 2007). Dispositional factors such as personality, specifically traits of Conscientiousness (Chamorro-Premuzic & Furnham, 2004), Openness to Experience (O'Connor & Paunonen), and approaches to learning (Biggs, 1978; Diseth & Martinsen, 2003; Diseth, Pallesen, Hovland, & Larsen, 2006) are also significant predictors.

In a longitudinal study of Australian youth (Gemici, Lim, & Karmel, 2013), individual differences among students were found to be a strong factor in determining tertiary entrance scores. Lizzio and Wilson (2010) identified another related non-cognitive factor impacting on student outcomes was their sense of purpose, that is, the extent to which they believed they were in the right degree program, and that their studies would lead them into a successful and satisfying career. They found that sense of purpose was the highest predictor of student satisfaction, and also was a significant predictor of retention and GPA. Lizzio and Wilson suggested that purposefulness provided a degree of resilience for students which helped them to persist in the face of perceived barriers or difficulties. Expectations and interest are also important. In a study of first year biology students, Bone and Reid (2013) found that students who perceived the course in a positive light were more motivated to succeed and were more likely to use effective learning strategies.

Burton and Dowling (2005, 2009) added to the prediction of success accounted for in intellectual ability by including an assessment of spatial ability, particularly visualisation skills, and the personality trait of Extroversion. Their finding in relation to Extroversion was in contrast to previous research (McKenzie, Gow, & Schweitzer, 2004), which found that introverted students were more likely to succeed in engineering studies. Burton and Dowling suggested that this result may reflect the fact that the cohort in their study was undertaking

courses that included problem-based learning in teams, which may tend to favour extroverted types over introverts.

Follow-up research by Burton and Dowling (2010) found further support for the influence on learning outcomes of non-cognitive factors, specifically the personality traits of agreeableness and emotional stability. The personality trait of introversion has been found to predict academic success for school leavers (McKenzie & Gow, 2004), but not necessarily for mature-aged students. McKenzie and Gow (2004) explained this finding by suggesting that the more outgoing young school leavers who scored high on extroversion might be diverted from their study by the social distractions of university life. Older extroverts may benefit from better self-regulatory skills and time managements strategies and are therefore less likely to be negatively influenced by their gregarious tendencies.

McKenzie and Gow (2004) found that the academic performance of mature-aged students, who might not have had any formal education for many years, was less important as a predictor of their achievement than for younger students. McKenzie and Gow found that despite the adjustment difficulties that mature-aged students may face, they tend to out-perform their younger counterparts in their first year of tertiary studies. They attributed this to the specific characteristics of the older group, such as an orientation towards more effective and efficient learning strategies. Other factors which may predict success with this cohort are work ethic, resulting from their work experience, and their motivation to succeed, based on their understanding of the financial cost of leaving the workforce to undertake their studies.

Lizzio and Wilson (2004a) suggested that developing effective learning approaches is important not only to ensure academic success, but more importantly, to facilitate problem solving skills which will better equip students for their ongoing professional career. They suggested that curricula should be designed to incorporate meta-learning strategies that enable students to critically reflect on their own goals and learning experiences.

There are conflicting findings on the interrelationships among the big five personality traits and deep, strategic, and shallow approaches to learning. Some research (e.g., Burton, Taylor, Dowling, & Lawrence, 2009; Zhang, 2003) suggests there is a substantial overlap between personality and approaches to learning. Zhang (2003) and Burton et al. (2009) each found that conscientiousness and openness to experience were positively related to deep learning, while neuroticism predicted a surface approach. Students who were high on conscientiousness were also likely to adopt an achieving (strategic as defined in this study) approach to learning.

McKenzie and Gow (2004) also found that personality traits were related to learning approaches, and that the relationships varied according to students' age status. For school leavers, the two most important predictors of approaches to learning were conscientiousness and internal locus of control. For mature-aged students, the most significant predictor of learning strategies was task value, with conscientiousness next. However, Chamorro-Premuzic and Furnham (2009) found that personality traits and learning approaches were largely independent constructs, and that underlying personality traits were not necessarily associated with approaches to learning, which were far more malleable and

reliant on context. While acknowledging that a limitation of their study was a reliance on self-report measures, which tend to elicit preferred rather than actual behaviours, their structural equation modelling failed to find any significant pathways between the constructs other than that between openness to experience and deep learning. They explained this link in terms of the intrinsic motivation typically displayed by students who are high in the openness to experience trait. Such students would therefore be likely to engage at a deeper level to achieve understanding in their studies and adopt approaches that enhance their enjoyment of learning.

A structural equation modelling approach by von Stumm and Furnham (2012) also found that while there was some shared variance among personality traits and approaches to learning, there were differences in the extent to which each of the approaches shared variance with personality. They found the greatest amount of variability associated with personality related to achieving learning (strategic learning approach), with 26% of the variance in this learning style being accounted for by extroversion, openness to experience, and conscientiousness, respectively.

Summary

To achieve the project objectives the project team developed a two-staged strategy:

1. Develop the Get Set for Success Quiz (i.e., cognitive and non-cognitive quizzes) to identify the key capabilities, knowledge, traits and skill sets that underpin success in first year engineering studies; and
2. Use the identified capabilities, knowledge, traits and skills to develop a prototype Engineering Career Appraisal Tool (EngCAT).

The development of the Get Set for Success Quiz was based on the findings and recommendations of many of the researchers who have studied the impact on student learning of different combinations of these characteristics. The design and deployment of the quiz to first year engineering students across the five partner universities are discussed in the next chapter.

Chapter 2: The Get Set for Success Quiz

The current project aimed to identify the key capabilities, knowledge, traits and skill sets that typically are suited to engineering studies. To do this, the team devised an online battery of tests (Get Set for Success Quiz). It included those skills and traits identified by the literature reviewed in chapter 1. This chapter discusses the development of the Get Set for Success Quiz and the results of the deployment across the five universities.

Designing the Get Set for Success Quiz

All partner universities had been already conducting some form of diagnostic pre-testing of their first year intake, particularly of mathematics and other cognitive knowledge. Mostly, the testing was designed to alert first year teachers to knowledge gaps of specific cohorts and to help them tailor their teaching to the needs of the cohort.

Importantly, the UQ lecturers noted that the real benefit of the online testing they had conducted was that students completed it before starting their studies and were therefore alerted to their own pre-entry knowledge gaps (Kavanagh, O'Moore, & Samuelowicz, 2009). Armed with such information, students could address their own specific weaknesses by accessing relevant information, revising school text books, or undertaking some remedial study before starting their course. It also helped them to adjust their expectations about what might lie ahead.

The test UQ used, an online competency quiz called Preparing for First Year (PFFY), provided individualised feedback about specific aspects of the first year engineering program. The PFFY formed the basis of the current project's Get Set for Success Quiz (cognitive component) and was adapted to incorporate additional items considered relevant to the engineering profession. The newly developed cognitive quiz consisted of 20 maths items, 14 physics items, 12 chemistry items, and 6 spatial ability items (Adams & O'Moore, 2007; Birk, n.d.; Gurgenci, n.d.; Halloun, Hake, & Masca, 1992; Kavanagh, O'Moore, & Samuelowicz, 2009; Lawrie, 2000; Midkiff, n.d.; Mulford & Robinson, 2002; Shallcross, 2007, 2009; Sutton, 2011; Thornton & Sokoloff, 1998). The items were presented as a multi-choice online cognitive quiz which took approximately one hour to complete, on average.

Get Set for Success Quiz Items

The project team undertook a risk management process while developing the Get Set for Success Quiz items to ensure they were free from bias and did not disadvantage either gender. Further, the team minimised this potential risk by critically reviewing quiz content to determine accessibility and equitability for both male and female students. Statistical techniques were used to examine for systematic gender differences in the Get Set for Success Quiz – none were evident in initial data analyses.

The non-cognitive component of the Get Set for Success Quiz incorporated aspects of personality, approaches to learning, and interest and motivation in engineering and was also administered online. Students responded to each self-report measure using a 5-point Likert scale, and testing took about 20 minutes to complete, on average. These self-report measures are each described below.

Personality

The 50-item version of the International Personality Item Pool (IPIP; Goldberg, 1992, 2001) was used to measure the big five factors of personality:

- Extroversion – a person's interest in interactions with others and levels of sociability;
- Agreeableness – a tendency to cooperate and trust others;
- Conscientiousness – self-discipline, reliability and persistence;
- Emotional Stability – self-reliance and the ability to deal with anxiety; and
- Openness to Experience – creativity and a preference for novel experiences.

This study labelled them as Extroversion, Agreeableness, Detailed (i.e., Conscientiousness), Relaxed (i.e., Emotional Stability), and Creative (i.e., Openness to Experience).

Learning Approaches

The 52-item Approaches and Study Skills Inventory for Students (ASSIST; Tait, Entwistle, & McCune, 1998) indicate the extent to which students' learning was deep, surface, and strategic:

- A Deep approach involves finding meaning in what is being studied to maximise understanding.
- A Surface approach involves investing little time in the academic task and memorising information with rote-learning.
- A Strategic approach involves being guided by the assessment criteria and enhancing self-esteem through competition.

Interest and Motivation for Studying Engineering Scale

The project team developed a 31-item self-report measure entitled Interest and Motivation for Studying Engineering (IMSE) to assess interests and attitudes to engineering (see Burton & Albion, 2013). Some questions drew from the test UTS used (Lowe & Johnston, 2008). The IMSE proved a reliable ($\alpha = .87$; Burton & Albion, 2013) measure of five subscales: Functional Creativity (e.g., *I like to know how things work*), Idealism (e.g., *I want to have a job that could change the world*), Conceptual Engagement (e.g., *I love maths*), Organisation (e.g., *I like to manage projects*), Inquisitiveness (e.g., *I have an enquiring mind*), Career Goals (e.g., *I have high standards for academic work*), and Self-efficacy (e.g., *I am confident I can complete my degree*). The IMSE scale is described in more detail below.

The IMSE scale was based on the work of Lowe and Johnston (2008) who measured non-cognitive factors that improved their selection of applicants for their engineering programs, particularly when they were trying to discriminate among applicants with lower range tertiary entrance scores. The instrument they developed in consultation with professional and industry organisations was a six-item structured questionnaire that asked students about specific aspects of their life which demonstrated their interest in engineering. For example, they might think of something they had created and indicate how it demonstrated engineering design. Responses to these questions were then scored on a scale from 0 to 5 based on relevance and the extent to which responses related to the nature and understanding of engineering as a discipline.

Using the traits Lowe and Johnston (2008) identified as being relevant to professional engineers and predictive of academic success, the 31-item IMSE scale was produced by reformatting items to allow for online application across a number of institutions. While open-ended questions provide rich data, responses are expensive and time consuming to analyse. For this reason the items were rewritten as statements which could be endorsed or refuted using a Likert response scale. In order to obtain "best" responses to the Lowe and Johnston items, team members who were professional engineers were invited to provide their responses and these were then written in statement form. In order to avoid response bias, four items were designed to be negatively scored ("*I believe that most problems require complex solutions"; "I would like to be an engineer because I like to work independently of others"; "If I find a solution to a problem, I like to stick with that solution"; and "If a solution to a problem does not emerge quickly, I prefer to move on to another task"*). Additional items relating to self-efficacy and goal setting for studying in general were also included. The statements generated by this process were then trialled with postgraduate engineering students and 31 items (23 interest items and 8 motivation items) that were highly endorsed were retained for use. Appendix B outlines measures in the non-cognitive component of the Get Set for Success Quiz.

Individual Feedback on Get Set for Success Quiz

A key consideration was the potential impact of the Get Set for Success Quiz results on students' perceptions of their suitability for engineering, both positive and negative. The personalised advice given to 2012 and 2013 cohorts on the basis of their quiz results focussed on empowering the individual to self-reflect on their prior experiences, knowledge, and skills and to better inform them of the pre-requisite skill sets that underpin entry into engineering programs.

All students across the five partner universities received personalised feedback on their current skill levels and, where appropriate, were linked to additional resources, including advice on bridging programs, to help them improve their knowledge and skills and enhance their prospects for success. Student feedback indicated a positive response to the Get Set for Success Quiz feedback, including a willingness to shape their behaviour to achieve a positive learning outcome.

Deploying the Get Set for Success Quiz

The Get Set for Success Quiz was developed in late 2011 and early 2012 and deployed online across the five partner universities during the period January 2012 to February 2012. The cognitive quiz was deployed at UQ in early January 2012 and then rolled out to the other four partner universities by week one of semester 1, 2012. The non-cognitive quiz was available to be deployed at all of the universities by the end of week 3, semester 1, 2012.

In 2012, information about the Get Set for Success Quiz (cognitive component) was sent to students enrolling in engineering at UQ with their admission information, and was provided to students at the week 1 of semester 1. Some members of the project team experienced some regrettable but unavoidable delays due to the ethics processes at their university or because of technical complications associated with deploying the online quiz on their student portal system.

This variability in timing of the cognitive quiz demonstrated the significance of having it available before the first semester started. Table 1 shows that participation and completion rates for the cognitive quiz were lower for those students who were invited to participate at orientation or after commencing their course. Follow-up focus group discussions with students across the partner universities confirmed this, with students admitting that once the semester had started, social and study commitments took precedence. They agreed that they would have been more motivated and had more time to complete the quiz if the invitation and link had been sent with their enrolment materials.

Table 1. *Participation Rates for the Get Set for Success Cognitive Quiz in 2012*

University	Time of administration	% of students logging in to commence cognitive quiz	% of students completing cognitive quiz
UQ	Prior to commencement of semester	70	60
USQ	At orientation	28	13
UNE	At orientation	34	17
UoN	In first week of semester	14	5
UTS	In third week of semester	7	2

Note. These rates are approximations only as enrolment numbers fluctuate early in the semester.

Another issue affecting the response rate was the staging of the quiz, with the cognitive quiz being made available before the non-cognitive quiz. The invitation to complete the non-cognitive quiz was sent to students at least three weeks after the semester started and the response rate was quite low. It appears that students were less likely to see the direct relevance of completing this second phase and getting feedback, and the delay compounded their reluctance to participate.

In order to achieve a better and more representative sample, the team received an extension to collect a second round of data in 2013.

With the only minor modifications needed for 2013, all universities were able to include information about the Get Set for Success Quiz to students with their enrolment materials. The modifications resulted from a preliminary analysis of the data from semester 1, 2012, which revealed that both the cognitive and non-cognitive quizzes could be shortened without significantly diminishing its impact and benefit.

Almost all students performed well on the spatial ability items, and while these were obviously skills relevant to engineering students, it was not necessary to include these items in the Get Set for Success Quiz (cognitive component) in 2013. Information from the personality inventory was also redundant to that provided by the learning approaches and aspects of the interest and motivation measure. These personality items were subsequently removed from the Get Set for Success Quiz (non-cognitive component) in 2013. The links for both components (cognitive and non-cognitive quizzes) of the Get Set for Success Quiz were sent at the same time, and a message at the end of the feedback for the cognitive quiz encouraged students to go on and complete the non-cognitive quiz. This proved to be

beneficial in improving the response rate for the cognitive quiz, but not for the non-cognitive quiz. Response rates for the non-cognitive quiz continue to be problematic and remain an issue to be addressed.

Due to institutional factors at UTS, the cognitive component they used in semester 1, 2013, was different in content from that measured across the other four partner universities. Therefore, their data were not suitable for inclusion in the overall analysis for semester 1, 2013. A summary of response rates for both the cognitive and non-cognitive quizzes across the two years of data collection is shown in Table 2.

Table 2. *Number of Get Set for Success Quiz Respondents in 2012 and 2013*

University	2012		2013	
	Cognitive	Non-cognitive	Cognitive	Non-cognitive
UQ	604	175	628	118
USQ	79	46	145	36
UNE	6	6	11	8
UoN	27	28	145	18
UTS	15	18	n/a	n/a

Analysis of the Interest and Motivation for Studying Engineering Scale

The 31-item IMSE scale was included in the 2012 non-cognitive quiz and was completed by 273 students. The reliability of the scale was investigated using SPSS, indicating that the items had good internal consistency ($\alpha = .87$). However, the negatively-scored items showed low inter-item correlations (< .3), and further analysis indicated that their only commonality was their negative valence. As these four items appeared problematic in terms of content and scale structure, they were eliminated from the scale. Factor analysis also revealed a number of complex items and one additional item was removed. The IMSE scale was reduced to 19 interest items (subscales 1 to 5 below) and 7 motivation items which formed another two subscales. The items comprising these subscales are outlined below.

Subscale 1: Functional Creativity

Item 7. I like to design and build things.
Item 8. I like to find solutions to practical problems.
Item 9. I usually sketch a diagram to start working out a problem.
Item 15. The first step I would take when solving a problem is to define the problem.
Item 19. I am a creative thinker.
Item 16. I am open to new ideas.

Subscale 2: Idealism

Item 11. I want to have a job that could change the world.
Item 12. I want to adapt systems so that they are more sustainable and have less environmental impact.
Item 18. Chemistry is fascinating.
Item 21. I like communicating my ideas to others.

Subscale 3: Conceptual Engagement

Item 4. I love maths.
Item 23. Physics is fun.

Subscale 4: Organisation

Item 24. I am a logical thinker.
Item 25. I like to manage projects.
Item 26. I like to focus on details.
Item 14. I enjoy working as part of a team.
Item 20. I will persist with a problem until I solve it.

Subscale 5: Inquisitiveness

Item 1. I like to know how things work.
Item 2. I like to know how things work better.
Item 10. I have an enquiring mind.

Subscale 6: Career Goals

Item 3. I have high standards for academic work.
Item 22. I have academic goals.

Subscale 7: Self-efficacy

Item 5. I have pictured myself being successful in my chosen profession.
Item 6. I am confident I have the ability to learn the necessary concepts to be successful in my studies.
Item 13. I am confident I have the ability to learn the necessary communication skills to be successful in my studies.
Item 17. I am confident I can complete my studies.

As the quiz items used in 2012 were refined in 2013, the data from the two cohorts will be analysed and discussed separately.

Analysis of the 2012 Cohort's Results for the Get Set for Success Quiz

The results of the Get Set for Success Quiz deployed in 2012 are presented in Table 3. The highest mean scores for the cognitive measures were achieved on spatial skills (9.7 out of 12) and maths (28.8 out of 36) and the lowest mean score was chemistry (12.5 out of 24). For the non-cognitive measures, students reported, on average, high means on Deep and Strategic learning approaches and low mean scores on Surface learning. The students, on average, scored moderate to high on Agreeableness, Detailed and Creative personality traits and moderate to low on Extroversion and Relaxed. The IMSE subscales were also endorsed, on average, at a high level, particularly on the Inquisitiveness subscale (4.5 out of 5).

Table 3. *Mean Scores for the 2012 Deployment of the Get Set for Success Quiz*

Measures	**Possible score range**	**Mean Score**	***SD***	***N***
Cognitive quiz				
Maths	0-36	28.8	6.1	753
Chemistry	0-24	12.5	12.4	746
Physics	0-28	18.4	4.7	743
Spatial Ability	0-12	9.7	2.5	760
Cognitive quiz total score	0-100	69.6	13.3	731
Non-cognitive quiz				
Deep learning	16-80	61.9	9.9	273
Strategic learning	20-100	74.4	12.8	273
Surface learning	16-80	47.0	10.9	273
Extroversion	1-5	3.1	0.9	273
Agreeableness	1-5	3.8	0.6	273
Detailed	1-5	3.7	0.7	273
Relaxed	1-5	3.2	0.8	273
Creative	1-5	3.7	0.7	273
Functional Creativity	1-5	3.9	0.6	273
Idealism	1-5	3.8	0.7	273
Conceptual Engagement	1-5	3.9	0.8	273
Organisation	1-5	3.9	0.7	273
Inquisitiveness	1-5	4.5	0.6	273
Career Goals	1-5	4.3	0.7	273
Self-efficacy	1-5	4.4	0.7	273

Student Reaction to the Get Set for Success Quiz

Students were given the opportunity to record their reactions towards completing the Get Set for Success Quiz (see Burton, Dowling, Kavanagh, O'Moore, & Wilkes, 2012). Evaluation items for the cognitive quiz were collected in 2012, and for the non-cognitive quiz in 2013. Overall, most students responded positively, indicating the quiz flagged the topics they needed to revise. It also gave them insight into what was needed for first year studies in engineering. The feedback for both 2012 and 2013 cohorts was combined and is summarised in Table 4.

Table 4. *Student Attitudes to Completing the Get Set for Success Cognitive Quiz (N = 731)*

Response options	% response
Benefit from doing quiz?	
It gave me insight into the knowledge I need for 1st year	56
It flagged some things I have forgotten and need to revise	82
I feel this is the beginning of my learning journey at uni	27
It made me feel that my needs were being assessed	27
No, it achieved none of the above	3
Are you glad you did it?	
Yes, I have a better idea of what I know and don't know	73
Yes, I have a better understanding of 1st year knowledge expectations	61
Yes, I feel more confident	28
I'm not glad I did it at all	5
Revise my high school notes	33
Find a relevant text book	58
Ask someone who knows for help	28
Do nothing as I'll pick it up during semester	19
Do nothing because I did well	8
I haven't disliked doing it at all	35
I forgot a lot of what I knew during the holidays	46
It has scared me	13
It was stressful	6
It didn't help	3
It was time consuming and boring	11
I was still in a holiday mood	35

Note. Responses total > 100% as students could endorse more than one response option.

As shown in Table 4, most students indicated an intention to take some action to revise material they had forgotten. While a small proportion of students did not see the value of the cognitive quiz, more than a quarter of those who responded found it a confidence-boosting experience.

Student reactions to non-cognitive quiz were also positive, but somewhat more ambivalent. For students to appreciate the value of the opportunity for self-reflection afforded by this questionnaire, they will need some guidance and encouragement from their teachers and also from within the actual course curriculum. Lizzio and Wilson (2004b) emphasised the importance of students' being able to self-assess their competencies, suggesting that such metacognitive awareness indicates professional and academic maturity, and is itself a skill that needs to be practised and learned. Most students were neutral about whether they enjoyed doing the non-cognitive quiz, but positive responses outweighed negative responses when assessing the usefulness of the self-reflective exercise. Most students agreed that they would use the information to change their study approach. Additionally, students' responses about whether or not the non-cognitive quiz helped them to better understand their interest in engineering were more positive than negative. A summary of 2013 non-cognitive quiz responses is found in Figures 1-3.

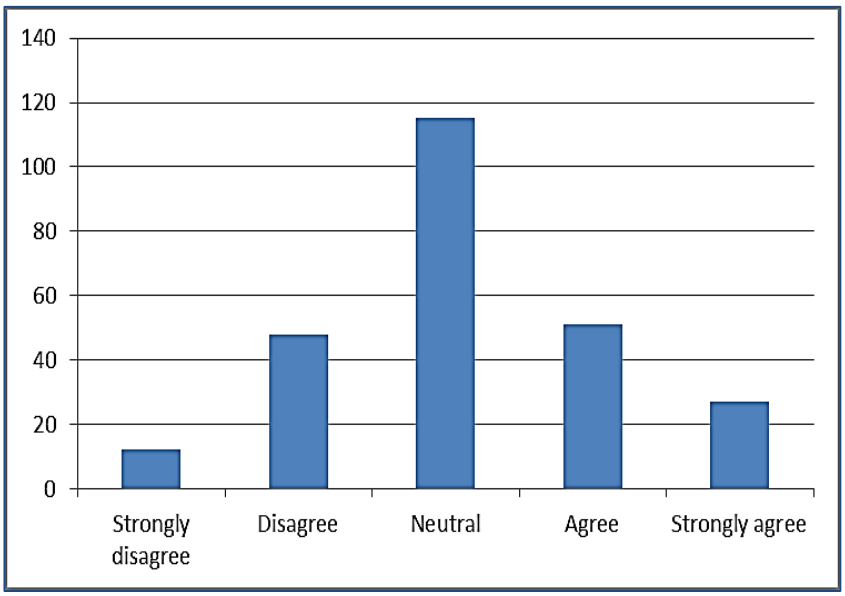

Figure 1. I enjoyed doing this [non-cognitive] quiz (*N* = 253).

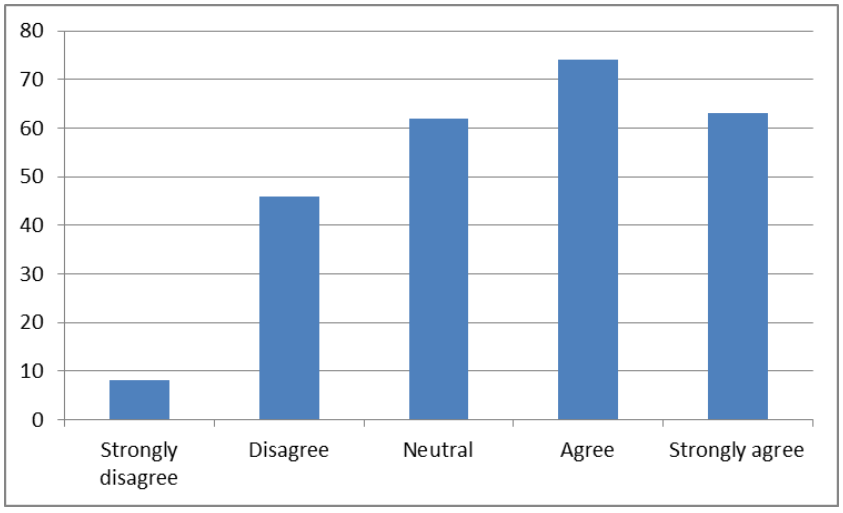

Figure 2. I will use the information from this [non-cognitive] quiz to help change my approach to my studies (*N* = 253).

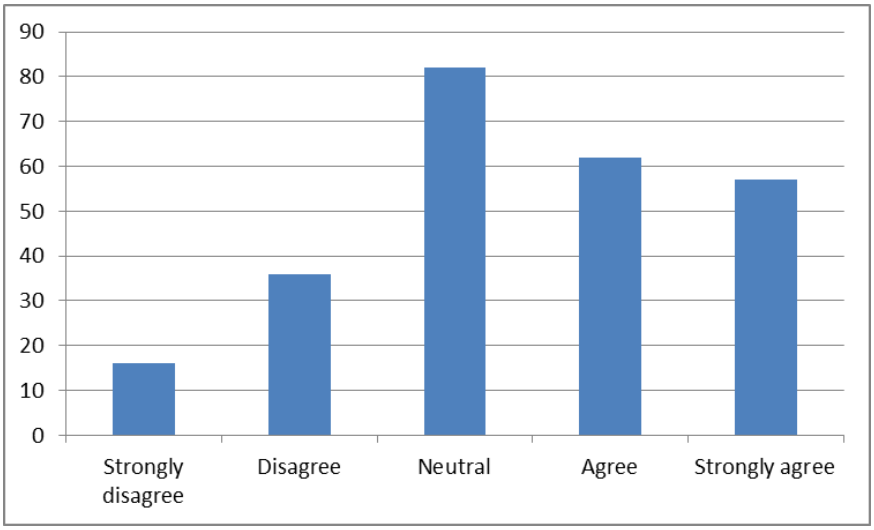

Figure 3. The [non-cognitive] quiz has helped me understand my interests in engineering (*N* = 253).

Measures of Academic Success

Academic success was defined in a variety of ways in this study. The simplest objective measure was grade point average (GPA) at the end of the 2012 students' first year of study. While there were some variations in the way in which GPA was calculated at each of the partner universities, student results were able to be classified as follows: 7 = high distinction, 6 = distinction, 5 = credit, 4 = pass, 3 = conceded pass, 1.5 = fail. A second measure of success (Retention) indicated whether or not students were still enrolled in the program. A third measure (Progression) related to the number of courses (subjects or units at some universities) passed in the first three semesters.

Table 5 shows the independent variables (i.e., both cognitive and non-cognitive quiz measures) that were significantly correlated with the three outcome variables (i.e., measures of academic success). Three cognitive quiz variables, maths, chemistry and physics scores, were each significantly correlated with GPA, Retention, and Progression measures, respectively. All three learning approaches were significantly correlated with GPA. As expected, the only variable to significantly negatively correlate with GPA was the Surface learning approach. Both the Detailed and Relaxed personality traits were significantly correlated with GPA; two of the IMSE subscale scores (Conceptual Engagement and Career Goals) were also significantly correlated with GPA. A similar, but less strong pattern of relationship emerged between the cognitive and non-cognitive quiz measures and the Progression and Retention variables.

Table 5. *Correlations between Get Set for Success Cognitive Quiz and Non-cognitive Quiz Scores and Measures of Academic Success for the 2012 Cohort*

Variable	GPA	Retention	Progression
Cognitive quiz			
Maths	.37**	.25**	.34**
Chemistry	.29**	.12**	.16**
Physics	.32**	.14**	.13*
Cognitive quiz total score	.41**	.19**	.27**
Non-cognitive quiz			
Approaches to learning			
Deep	.25**	.16**	.14*
Strategic	.30**		.26**
Surface	-.27**		-.25*
Personality			
Detailed	.20**		
Relaxed	.14**		.16**
Creative			.16**
Interest and motivation			
Functional Creativity			-.17*
Conceptual Engagement	.30**		.25**
Career Goals	.27**		.21**
IMSE total scale score	.20**		

Note. $^{**}p < .01$, $^{*}p < .05$ IMSE = Interest and Motivation for Studying Engineering

As the cognitive quiz total score was significantly positively correlated with each of the three outcome variables, it was decided that, for the purposes of parsimony, the total scale score should be used in subsequent analyses rather than the separate maths, physics, and chemistry scores. While the various subscales of the IMSE measure seemed to correlate inconsistently with each of the outcome variables, it was decided to investigate its properties separately for Progression and as an overall predictor of GPA.

Regression Analyses

In order to determine the relative predictive value of the different independent variables in the study, hierarchical regression analyses, wherein the order that variables are entered into the analysis is determined by the researcher, were conducted for each of the three outcome variables (i.e., GPA, Retention and Progression). The order of entry at each step was informed by the correlation data. It is clear from Table 5 that cognitive skills are the strongest correlates of academic success. Therefore, in order to examine the unique additional contribution that the non-cognitive variables make to the prediction of academic success, cognitive skills were controlled for by entering the cognitive quiz total score at step 1 of each regression analysis. When evaluating the predictors of GPA, the cognitive quiz total

score (β = .52, t = 8.32, p < .001) was found to predict 27% of the variance in GPA (R^2 = .27). When the IMSE total scale score was entered at step 2, the increase in the prediction of GPA was significant (R^2 = .02, $F_{(1,188)}$ = 5.67, p < .05). Scores on the three learning approaches (Surface, Strategic, and Deep) were added at step 3, increasing R^2 to .34. However, the only one of these to make a significant unique contribution to the prediction of GPA was Strategic learning (β = .26, t = 3.07, p < .01). The regression analysis is summarised in Table 6.

Table 6. *Hierarchical Regression of GPA on Get Set for Success Cognitive Quiz and Non-cognitive Quiz Measures for the 2012 Cohort*

Dependent variable	**Independent variables**	β	sr^2	β	sr^2	β	sr^2
		Step 1		Step 2		Step 3	
GPA	Cognitive quiz total score	.52	.27**	.48	.22**	.50	.21**
	Interest and Motivation for Studying Engineering (IMSE) total scale score			.15	.02*	.05	.00
	Deep learning					-.08	.00
	Strategic learning					.27	.05**
	Surface learning					-.03	.00
		Step1 R^2 = .27 R^2(adj) = .26		*Step2:* R^2 = .29 R^2(adj) = .28		*Step3:* R^2 = .34 R^2(adj) = .33	

Note. * p < .05, **p < .01

As expected, relevant course-related cognitive skills and knowledge are reliable and strong predictors of academic success, as measured by GPA. However, this analysis indicates that it is far from being the only key predictor. Interest in, and motivation for, studying engineering is also significant, as is a Strategic approach to learning. Strategic learners are motived to obtain the best possible mark by effectively organising their study time and learning environments. It is therefore not surprising that people with these characteristics aim to understand what they learn and relate new concepts to ideas already assimilated, and consequently achieve high academic success.

Similar regression analyses were conducted on the Retention and Progression outcome variables. Again, as cognitive skills were the variables found to be most highly correlated with these outcome variables, they were controlled for by entering the cognitive quiz total score at step 1 in each case. The cognitive quiz total score (β = .20, t = 2.82, p <. 01) was found to predict 4% of the Retention measure (R^2 = .04). Deep Learning was entered at step 2, but it did not add significantly to the prediction of Retention (R^2 = .04, $F_{(1,201)}$ = 1.07, p > .05).

When regressing the relevant variables onto the Progression measure, the cognitive quiz total score at step 1 (β = .35, t = 4.91, p <. 01) significantly predicted 13% of the variation in Progression. Deep, Surface and Strategic learning were added at step 2. Of these, only Strategic learning made a significant contribution, increasing R^2 to .21. Three of the IMSE subscales (Functional Creativity, Conceptual Engagement, and Career Goals) were added at step 3. These non-cognitive measures added to the prediction. The total predictive value of the regression was .30, indicating that these variables were able to predict 30% of the variance in Progression (i.e., the number of courses passed by students in their first three semesters). The regression analyses for Retention and Progression are summarised in Table 7.

Table 7. *Hierarchical Regressions of Retention and Progression on Get Set for Success Cognitive Quiz and Non-cognitive Quiz Measures for the 2012 Cohort*

Dependent variable	**Independent variables**	β	sr^2	β	sr^2		
		Step 1		Step 2			
Retention	Cognitive quiz total score	.20	.04**	.17	.03*		
	Deep learning			.07	.00		
		Step1 R^2 = .04 R^2(adj) = .03		*Step2:* R^2 = .04 R^2(adj) = .03			
		β	sr^2	β	sr^2	β	sr^2
		Step 1		Step 2		Step 3	
Progression	Cognitive quiz total score	.35	.12**	.36	.10**	.34	.09**
	Deep learning			-.22	.03	-.14	.01
	Strategic learning			.30	.07**	.28	.05**
	Surface learning			-.08	.00	-.06	.00
	Functional Creativity					-.28	.06**
	Conceptual Engagement					.03	.00
	Career Goals					.15	.02
		Step1 R^2 = .13 R^2(adj) = .12		*Step2:* R^2 = .21 R^2(adj) = .20		*Step3:* R^2 = .30 R^2(adj) = .27	

Note. * p < .05, **p < .01

Summary of 2012 Student Results for the Get Set for Success Quiz

In 2012, the key predictors of academic success (as measured by GPA and Progression) were the Conceptual Engagement, Career Goals, and Functional Creativity subscales. Conceptual Engagement reflects students' interest in maths and physics concepts, and it is not surprising that this emerged as a key predictor of GPA in students' first semester of study, given that cognitive abilities have reliably been shown to positively predict academic success over time in engineering programs (e.g., Burton & Dowling, 2009; Burton et al., 2012). However, the content measured in this scale went beyond mere cognitive ability in these areas, by tapping into students' attitudes to and enjoyment of these subjects. Students who did well in maths and physics and who engaged with these topics in a positive way were most likely to succeed in first year engineering courses. On the other hand, it is somewhat disconcerting to note that functional and creative interests were a negative predictor of short-term student persistence, which could suggest that the curriculum in first year is not designed to engage those interests. There is a danger that some students who may be high in creativity, practicality, and innovation may be lost to the profession because of their first year experience. In contrast, the Career Goals subscale positively added to the prediction of Progression, indicating that an interest in showing attention to detail may help students to persist with their engineering studies over time. Further research is warranted to track student progress, however, these analyses are beyond the scope of the current project.

Analysis of the 2013 Cohort's Results for the Get Set for Success Quiz

In order to achieve a higher response rate and to provide data to enable further psychometric analysis of the newly developed IMSE scale, the Get Set for Success Quiz was deployed at each partner university for the second time in semester 1, 2013.

Assessing the Factor Structure of the IMSE for 2013

Deliberation by the project team resulted in the rewording of some items in the IMSE scale to clarify their meaning. The refined 26-item IMSE scale was again administered online with the 2013 cohort as part of the Get Set for Success Quiz (non-cognitive component).

A principal axis factoring (PAF) analysis was conducted to confirm the factor structure of the 26-item IMSE scale which emerged in 2012. The 19 interest items were analysed separately from the 7 motivation items. The analysis was constrained to extract five factors which together accounted for 55% of the variance, but the items did not load onto the same factors as before. Items on the Inquisitiveness and Functional Creativity factors loaded together, as did some items from the Organisation and Conceptual Engagement factor. Item 18 relating to chemistry ("*chemistry is fascinating"*) loaded onto a separate factor, however, one item is insufficient to adequately define this factor and additional items should be developed for further research with this scale. Item 26 ("*I like to focus on details"*) did not load onto any factor. The details of this factor analysis are presented in Table 8.

Table 8. *Pattern Matrix of Interest Items from the IMSE Scale – Principal Axis Factoring: Oblimin with Kaiser Normalisation (N = 180)*

Variable	Factor 1 Functional Creativity	Factor 2 Collaboration	Factor 3 Conceptual engagement	Factor 4 Idealism	Factor 5 Undefined
Item 1	.65				
Item 2	.60				
Item 4			-.67		
Item 7	.90				
Item 8	.55				
Item 9	.41				
Item 10	.59				
Item 11					
Item 12					
Item 14		.53			
Item 15		.41			
Item 16		.37			
Item 18					.31
Item 19	.54				
Item 20			-.40		
Item 21		.65			
Item 23			-.35		
Item 24			-.59		
Item 25		.47			
Item 26					
Eigenvalues	5.45	1.62	1.49	1.31	1.07
% of variance	27.24	8.09	7.45	6.53	5.33
Correlation matrix					
Factor 1	1.00				
Factor 2	.39	1.00			
Factor 3	-.33	-.26	1.00		
Factor 4	-.24	-.27	.23	1.00	
Factor 5	.18	.07	-.20	-.17	1.00

A principal component analysis was conducted on the remaining six motivation items as issues with communalities prevented principal axis factoring. The results confirmed the analysis of the 2012 data, with two factors emerging with eigenvalues greater than one, accounting for 59% of the variance. The items were loaded on the factors as previously described. A summary of the factor analysis is presented in Table 9.

Table 9. *Pattern Matrix of Motivation Items from the IMSE Scale – Principal Component Analysis: Oblimin with Kaiser Normalisation (N = 180)*

Variable	Factor 6 Self-efficacy	Factor 7 Career Goals
Item 3		.81
Item 5	.61	
Item 6	.91	
Item 13	.48	
Item 17	.78	
Item 22		.81
Eigenvalues	2.30	1.23
% of variance	38.30	20.55
Correlation matrix		
Factor 6	1.00	
Factor 7	.26	1.00

The 24 items comprising the revised 6-factor structure of the IMSE scale are listed below.

Subscale 1: Functional Creativity (7 items)

Item 1. I like to know how things work.
Item 2. I like to know how things work better.
Item 7. I like to design and build things.
Item 8. I like to find solutions to practical problems.
Item 9. I usually sketch a diagram to start working out a problem.
Item 10. I have an enquiring mind.
Item 19. I am a creative thinker.

Subscale 2: Collaboration (5 items)

Item 14. I enjoy working as part of a team.
Item 15. The first step I would take when solving a problem is to define the problem.
Item 16. I am open to new ideas.
Item 21. I like communicating my ideas to others.
Item 25. I like to manage projects.

Subscale 3: Conceptual Engagement (4 items)

Item 4. I love maths.
Item 20. I will persist with a problem until I solve it.
Item 23. Physics is fun.
Item 24. I am a logical thinker.

Subscale 4: Idealism (2 items)

Item 11. I want to have a job that could change the world.
Item 12. I want to adapt systems so that they are more sustainable and have less environmental impact.

Factor 5: Undefined

Subscale 6: Career Goals (2 items)

Item 3. I have high standards for academic work.
Item 22. I have academic goals.

Subscale 7: Self-efficacy (4 items)

Item 5. I have pictured myself being successful in my chosen profession.
Item 6. I am confident I have the ability to learn the necessary concepts to be successful in my studies.
Item 13. I am confident I have the ability to learn the necessary communication skills to be successful in my studies.
Item 17. I am confident I can complete my studies.

Analysis of the 26-item IMSE scale identified by the 2012 factor analyses showed that the refined 24-item IMSE total scale again demonstrated a satisfactory reliability coefficient in 2013 (α = .86). However, some of the subscales will need to be augmented with additional items to improve their internal consistency. See Table 10 for the reliability statistics of the IMSE for the 2013 student cohort.

Table 10. *Reliability Measures for the IMSE Total Scale and Subscales in 2013 (N = 180)*

Scale	**α co-efficient**
IMSE total scale score	.86
Subscales	
Functional Creativity	.83
Collaboration	.63
Conceptual Engagement	.62
Idealism	.59
Career Goals	.57
Self-efficacy	.68

A summary of the descriptive statistics for the Get Set for Success Quiz measures in 2013 are presented in Table 11. The results were similar to those achieved in 2012 and it should be noted that students again rated highly on the IMSE scales.

Table 11. *Get Set for Success Quiz Mean Scores for the 2013 Cohort*

Cognitive quiz	**Possible score range**	**Mean Score**	**SD**	**n**
Maths	0-40	30.5	7.7	807
Chemistry	0-24	12.1	5.5	807
Physics	0-28	18.1	4.9	807
Total quiz score	**0-92**	**60.7**	**14.6**	**807**
Non-cognitive quiz				
Deep learning	16-80	63.1	8.4	180
Strategic learning	20-100	76.2	12.7	180
Surface learning	16-80	47.2	11.7	180
Functional Creativity	1-5	4.2	0.6	180
Idealism	1-5	4.2	0.7	180
Conceptual Engagement	1-5	4.2	0.6	180
Collaboration	1-5	4.1	0.5	180
Career Goals	1-5	4.3	0.6	180
Self-efficacy	1-5	4.4	0.6	180

As in 2012, GPA was again highly correlated with a number of the cognitive and non-cognitive quiz measures. Additionally, the number of courses passed (Progression) was correlated with the three cognitive quiz measures (maths, chemistry, and physics) and the cognitive quiz total score. Career Goals (i.e., the extent to which students set high study goals) was also significantly correlated with Progression. However, Retention at the end of first semester (semester 1, 2013) was not significantly correlated with any Get Set for Success Quiz measures. A summary of the significant correlations is in Table 12.

Table 12. *Correlations between Get Set for Success Cognitive Quiz and Non-cognitive Quiz Scores and Measures of Academic Success for the 2013 Cohort*

	GPA	**Retention**	**Progression**
Cognitive quiz			
Maths	.17**		.29**
Chemistry	.11**		.17**
Physics	.13**		.15**
Cognitive quiz total score	**.18****		**.26****
Non-cognitive quiz			
Approaches to learning			
Strategic	.19**		
Surface	-.23**		
Interest and Motivation (IMSE)			
Career Goals	.29**		.19*

Note. ** $p < .01$, * $p < .05$

Hierarchical regression analyses were again conducted based on the correlation data. As only one of the six subscales of the IMSE scale (Career Goals) was significantly related to GPA, the Career Goals score rather than the total IMSE score was used in investigating GPA and Progression, respectively.

Cognitive skills were again controlled for by entering the cognitive quiz total score at step 1 of the regression. The cognitive quiz total score (β = .43, t = 5.74, p < .001) was found to predict 18% of the variance in GPA (R^2 = .18). The addition of the Career Goals score at step 2 increased the prediction of GPA to 24%, however, when the scores on two of the learning approaches (Surface and Strategic learning) were added at step 3, they did not add significantly to the prediction. The result of this regression analysis was only somewhat consistent with results obtained for the 2012 cohort, and is summarised in Table 13.

Table 13. *Hierarchical Regression of GPA on Get Set for Success Cognitive Quiz and Non-cognitive Quiz Measures for the 2013 Cohort*

Dependent variable	**Independent variables**	β	sr^2	β	sr^2	β	sr^2
		Step 1		Step 2		Step 3	
GPA	Cognitive quiz total score	.43	.18**	.41	.16**	.41	.15**
	Career Goals			.23	.05**	.18	.03*
	Strategic learning					.15	.02
	Surface learning					-.01	.00
		Step1 R^2 = .18 R^2(adj) = .18		*Step2:* R^2 = .24 R^2(adj) = .23		*Step3:* R^2 = .26 R^2(adj) = .24	

Note. * p < .05, **p < .01

As no variables were found to correlate with Retention at the end of the students' first semester of study, no further analysis was conducted on that outcome variable. When exploring the Progression measure, the cognitive quiz total score at step 1 (β = .16, t = 2.12, p < .05) significantly predicted 3% of the variation in Progression. The Career Goals score was added at Step 2, increasing the prediction to 6%. The regression analysis for Progression is summarised in Table 14.

Table 14. *Hierarchical Regression of Progression on Get Set for Success Cognitive Quiz and Non-cognitive Quiz Measures for the 2013 Cohort*

Dependent variable	**Independent variables**	β	sr^2	β	sr^2
		Step 1		Step 2	
Progression	Cognitive quiz total score	.16	.03*	.15	.02*
	Career Goals			.18	.03*
		Step 1 R^2 = .03 R^2(adj) = .02		*Step 2:* R^2 = .06 R^2(adj) = .05	

Note. * $p < .05$

Summary of 2013 Student Results for the Get Set for Success Quiz

In 2013, the Get Set for Success Quiz again proved to be an effective transition tool as it enabled first year engineering students to use their individual feedback to review and build their knowledge and skills before beginning their university studies. This approach meets the principle of early identification of issues established by Tinto (1987, 1993, 1995). The students who completed the quiz generally found it to be a positive experience and indicated that they would use the information to help them prepare for their studies and to develop a more effective approach to learning. Wilson and Lizzio (2008) also pointed out the importance of helping students feel more confident about their ability to undertake their chosen course of study, and some students indicated that the quiz had served that purpose for them. It is hoped that others might have developed more confidence as they accessed the links to online assistance and resources provided as part of the individualised feedback.

The importance of developing good learning approaches and effective study practices was again demonstrated in the current study. This aligns with previous studies that show these are critical predictors of academic success (e.g., Burton & Dowling, 2009; Burton et al., 2009; Lizzio & Wilson, 2004a). For the 2013 cohort, there was again a strong negative correlation between students' GPA at the end of their first semester of study and a Surface learning approach; there was a strong positive correlation between GPA and the Strategic learning approach, as expected.

The IMSE scale, which was specifically developed for this project, is clearly relevant to assessing the interests and motivations to study engineering of prospective engineering students. The results for both student cohorts identified strongly with the traits and attributes included in the self-report scale. Its qualities as a predictor of academic success appear to strengthen over time with a number of the subscales having a unique additional contribution to the prediction of GPA and Progression after three semesters of study. Further research to refine this scale is warranted.

Chapter 3: Developing EngCAT

The main deliverable from this project was a prototype of the online Engineering Career Appraisal Tool (EngCAT). The EngCAT website includes information about careers in engineering and links to other sources of information to inform career decision making. A key component of EngCAT is the newly developed Interest and Motivation for Studying Engineering (IMSE), an online self-report questionnaire measuring prospective students' interests and motivations for engineering. Additionally, self-report measures of learning approaches and personality were included to provide personalised feedback and help prospective students better manage their study behaviours and get set for success in university. The decision to include these measures from the Get Set for Success Quiz (non-cognitive component) was based on the results of deploying the quiz in 2012 and 2013 across the five partner universities. This chapter describes the design and development of the EngCAT prototype and outlines strategies for attracting, motivating and retaining students to the engineering profession.

EngCAT Design Criteria

Before the project team could develop a prototype model for EngCAT, they had to identify, define and validate the key design criteria. Based on their existing research they adopted the following key design criteria for EngCAT:

- EngCAT should help prospective students to make informed career choices and thereby increase their level of decidedness about their career choice and intended program of study;
- EngCAT should enable students to self-assess their readiness to study engineering;
- EngCAT should attract those students who are most suited to the engineering discipline, particularly those who have not considered engineering as a career; and
- EngCAT should help those year 10 high school students who want to pursue a career in engineering, to select the most appropriate subjects for their final years at school.

Thus, EngCAT was designed to provide prospective students with individual feedback on their readiness and suitability to study engineering, and provide information about the engineering profession that will enable them to make informed career choices. It is important to note that because EngCAT was designed for prospective engineering students, with a particular focus on year 10 students, only non-cognitive self-report measures are included in the EngCAT self-tests. This is because the cognitive items in the Get Set for Success Quiz are not appropriate for junior high school students; they will not acquire the required knowledge and skills in mathematics, physics and chemistry until they complete these subjects in years 11 and 12 at high school. Hence the need for the EngCAT website to provide year 10 students with information that will enable them to select the subjects that will enable them to develop the required knowledge and skills in these cognitive domains. Additionally, the EngCAT website provides a focus on students' interests in an "engineering career" and outlines various fields within the discipline that might be explored.

Developing the EngCAT Prototype

The project team undertook the following tasks which were considered crucial to the successful development and deployment of the EngCAT prototype:

1. Identified the key factors that underpin success in first year engineering studies by examining relationships between the Get Set for Success Quiz results and measures of academic success (i.e., GPA, Retention and Progression);
2. Developed and refined the Interest and Motivation for Studying Engineering (IMSE) scale, a self-report questionnaire to enable prospective students to self-assess their knowledge, interest and motivation to determine their suitability and readiness to study engineering;
3. Developed a mechanism to provide participants who complete the IMSE scale and self-report measures of personality and learning approaches with individual feedback about their non-technical skills;
4. Identified online sources of relevant information about engineering careers in Australia and New Zealand, and the diversity of those careers; and
5. Identified links to the key providers of undergraduate engineering programs in Australia and New Zealand.

The main focus during 2012 was to conduct the research necessary to complete the first three tasks. The focus in 2013 was to identify and locate resources and then develop and refine the EngCAT prototype. These activities are described in the following sections.

Choosing a Career

Career decision making is the process of choosing a career and is one of life's most important decisions. Career decidedness reflects how certain people are in choosing a career (Osborn & Zunker, 2006); career decided individuals typically show little uncertainty regarding their career choice. It is assumed that being decided in one's career will result in satisfying careers (Earl & Bright, 2007). In the higher education context, an appropriate measure of students' career satisfaction is satisfaction with one's major field of study (Nauta, 2007). Its equivalency to future satisfaction lays in the premise that students' majors share characteristics with their future occupational environments. Major satisfaction is therefore defined as the degree to which tertiary students are globally satisfied with their major field of study (Nauta, 2007). Students who are decided about their future career and satisfied with their major field of study tend to be motivated to achieve high academic success (Nauta, 2007).

Similarly, students' sense of purpose – the extent to which they believe they are in the right degree program and that their studies will lead to a successful and satisfying career (Lizzio & Wilson, 2010) – is fundamental to successful student transition. In fact, sense of purpose is a key predictor of student satisfaction, and a significant predictor of retention and grade point average (Lizzio & Wilson, 2010). It is argued that purposefulness provides a degree of resilience for students, which helps them to persist in the face of perceived barriers or difficulties (Lizzio & Wilson, 2010).

While commencing students leave institutions or change programs for a variety of reasons, most withdraw because of transitional issues relating to mismatched or ill-formed goals or a

sense of feeling isolated, rather than intellectual issues. Inappropriate discipline choice is also a major cause of student withdrawal (Yorke & Longden, 2008). Many withdraw from courses early to change institutions or enrol in different courses at the same university. This implies poor career decision making before their enrolment, or that they had inadequate or unrealised expectations of the courses they had initially chosen. Although career choice and its impact on academic success has gained some attention (Brown et al., 2008), there is considerable scope to explore this relationship in engineering, particularly as prospective students are often poorly informed about the discipline and the coursework it involves (Krause, Hartley, James, & McInnis, 2005).

Measuring Students' Interest and Motivation in Engineering

This project aimed to identify the key characteristics of the commencing first year engineering students that influence successful transition to university life and likely success in first year engineering studies. While cognitive ability and previous academic success are predictive of future academic success, a broader range of non-technical skills (i.e., attitudes and social skills) are also important. Lowe and Johnston (2008) observed that academic success in high school was only moderately correlated with success in university engineering courses, and they suggested that measuring non-cognitive aspects, including interest and motivation, could improve the prediction of success in first year.

Feedback from the EngCAT self-tests enable prospective students to link with an explanation of the different engineering disciplines to further explore these interests with a specific career focus. They are linked with examples of "engineers in practice" to pique their interest and motivate them to explore their interest in becoming an engineer.

For example, analysis of the IMSE in 2012 and 2013 indicated that the Functional Creativity subscale, measuring students' interest in designing and building things and finding creative solutions to practical problems, was related to academic success in first year engineering studies. An interest in these skills would suggest a good fit with a career in engineering. Some of the many types of engineers that suit a keen interest in Functional Creativity skills include: aerospace engineers (design airplanes or space vehicles); biomedical engineers (design medical equipment); chemical engineers (make medicines from chemicals); civil engineers (design roads, bridges, and buildings); electrical engineers (design electrical equipment); and mechanical engineers (design machines like cars and trains).

Additionally, the Conceptual Engagement subscale of the IMSE measured students' love of maths and physics. This subscale added to the prediction of academic success (both GPA and Progression) in the 2012 cohort, indicating that these cognitive skills are linked to assessment in first year engineering. Accordingly, students are encouraged to explore various engineering careers to see how they can put these skills into practice when working as an engineer.

Finally, the Career Goals subscale measured students' motivations for learning and standards for academic work. This subscale was related to academic success in both 2012 and 2013 cohorts, demonstrating the importance of first year students in establishing a strong sense of purpose and an early focus on their goal to become a professional engineer.

The EngCAT self-tests thus enable prospective engineering students to better understand the traits and skill sets relevant to the engineering profession. Analysis of the 26-item IMSE scale identified by the 2012 factor analyses showed that the refined 24-item IMSE total scale again demonstrated a satisfactory reliability coefficient in 2013 (α = .86). Further research is recommended to improve the psychometric properties of the IMSE scale, for example, some of the subscales should be augmented with additional items to improve their internal consistency. This will be the focus of future research to be led by the project leader.

EngCAT Personalised Feedback

Self-testing cognitive skills could narrow the intake to those who indicate a "good fit" with engineering. However, the aim of this project is to widen the pool of prospective students by empowering engineering schools to develop alternative entry pathways to suit their market and geographic location. Students with an interest in engineering who do not meet the normal entry requirements should be provided with education pathways to upskill and gain entry. Therefore, the EngCAT self-tests focused on enhancing prospective students' understanding of their social skills, and demonstrating their relevance to their engineering studies. The personalised feedback was designed to encourage students who have the right skill sets, but have not considered engineering, to choose engineering as their preferred study option.

Given the key predictors of academic success identified in this research, the project team included self-report measures of learning approaches and personality in the EngCAT prototype in addition to the newly developed IMSE. For example, the personality feedback was specifically designed to provide an overview of participants' preferred tendencies, outline how they prefer to engage in the workplace, and provide information relevant to communication and teamwork dynamics. It is hoped that prospective students who receive this personalised feedback via the EngCAT self-tests will gain insight into the importance of these non-technical skills in their engineering degree, and better understand the relevance of teamwork and communication in the profession. The project leader prepared a video presentation to help first year engineering students better understand the feedback on personality and learning approaches to enhance students' self-knowledge and help them optimise their study efforts. This video link (http://player.vimeo.com/video/42529171) is available via the EngCAT website.

The self-report measure of learning approaches and the newly developed Interest and Motivation for Studying Engineering (IMSE) scale provide individual feedback designed to make prospective students more aware of their individual learning approaches and whether they have the interest, skills and abilities that predispose them to success in engineering studies. For example, students who are interested in engineering but who lack the identified skill sets, will better understand which aptitudes they need to develop. This enhanced self-awareness will help them to seek support where needed and better manage their learning.

Refining the EngCAT Website

If the EngCAT prototype is to serve its purpose then it must be intuitive and easy to use. A prototype was developed in January 2013 on a WordPress site and this was then circulated to key stakeholders and the project reference group members for comment. A website design and development team at USQ was then assembled in August 2013 to review and refine the EngCAT website, based on the feedback received. The members of the EngCAT website team brought the following knowledge and skills to bear on this process:

- Psychological skills;
- Career planning and advice;
- Online architecture;
- Graphics design;
- Website development; and
- Copyright and intellectual property considerations.

The refined EngCAT website is designed to help prospective students explore their interest in engineering. It includes the following information and resource pages:

- Welcome to EngCAT;
- What is engineering;
- Education pathways;
- Engineering careers;
- Women in engineering; and
- Quizzes (engineering puzzles and self-tests).

EngCAT includes the following self-report measures of non-cognitive skills:

- IMSE scale developed by the project team to assess students' interest and motivation for studying engineering;
- IPIP (Goldberg, 2001) to determine how personality affects the way individuals approach work and study; and
- ASSIST (McCune et al., 1998) to find out how individuals can develop their approach to learning to help improve their chances of academic success.

The EngCAT website is hosted by the lead university, USQ, which will maintain and update the site when necessary. The following career and engineering organisations are developing links from their site to the EngCAT website:

- Engineers Australia;
- Australasian Association of Engineering Education; and
- myfuture careers website.

The EngCAT website can be accessed at the following URL: http://engcat.usq.edu.au

Strategies to Attract and Motivate Students to Engineering

A key finding of this study is the importance of non-cognitive skills as a predictor of success in engineering studies. Given the nature of engineering, it was unsurprising that this project found a relationship between cognitive skills (e.g., maths, chemistry, and physics) and academic success. However, this study highlighted that these skills alone did not predict

success. Also crucial for students were non-cognitive factors, in particular, learning approaches and interest and motivation in engineering. Thus, students with extremely high mathematical abilities may not necessarily succeed in engineering if they lack interest in the discipline or do not adopt an appropriate learning approach. The project team developed the Interest and Motivation for Studying Engineering (IMSE) scale to measure aspects of these non-cognitive factors – functional creativity, conceptual engagement, organisation, inquisitiveness and self-efficacy.

As a result, an important recommendation from this project is to place more emphasis on these non-cognitive skills in attracting prospective engineering students. It is a mistake to assume that just because someone has high cognitive abilities that they will automatically succeed in engineering studies. Those cognitive traits must also be paired with the right non-cognitive skills. The EngCAT self-tests are a way to measure those broader skills. Those students who score highly in both the cognitive and non-cognitive areas thus show a strong predisposition for success in engineering and should be encouraged to consider this discipline of study. Those who do not score as highly in the non-cognitive areas are not necessarily ruled out of engineering studies. In fact, it is extremely useful for them to identify that they need to work on these skills to improve their chances of success. What is vital is that prospective engineering students undertake these self-tests and gain these insights before they make their career choice and embark on their first year studies.

In practical terms, this project recommends that EngCAT should be deployed widely to identify and attract students with the right skill set for engineering, and also to assist those interested in engineering to understand the broader traits required, over and above mathematical ability, for example. EngCAT should be made available via:

- high school career adviser networks;
- government career advice websites;
- websites of all Australian universities offering engineering; and
- Engineers Australia website.

It is important that those who are exploring career options, particularly secondary schools students, receive both timely and relevant information about the careers that interest them, as well as the careers that they may not have considered but would suit their characteristics. For example, towards the end of year 10 most Australian high school students have to choose the subjects they will study in years 11 and 12.

The purpose of EngCAT is to provide prospective students with more relevant and targeted information about careers in engineering. This information is particularly relevant for year 10 students who engage in the early stages of career decision making. The information is focussed on informing prospective students about the types of careers and specialisations available in engineering, their readiness to study engineering, the different career paths to becoming an engineer to help them identify what subjects to study in senior at high school. They will also see where they can study in Australia and New Zealand to become an engineer, and see how engineers can meet challenges and find solutions to problems.

It is further envisaged that providing personalised feedback via the EngCAT self-tests will develop students' sense of purpose – their commitment to the goal of becoming an

engineer. Facilitating a sense of purpose in prospective engineering students is expected to facilitate successful transition into and engagement with first year engineering studies (cf. Lizzio & Wilson, 2010).

Thus, EngCAT has been designed to enable prospective students with an interest in engineering to confirm their career decision and to choose their final year subjects with that in mind. This may include accessing support for skills development, or a careers service unit for support with study skills, motivation and an understanding of how to explore the engineering profession. It is hoped that EngCAT will also attract students and other people who are qualified to study engineering but who have never considered engineering as a career.

Conclusion

In sum, EngCAT represents an important first step in attracting additional students into engineering programs and in addressing student attrition. EngCAT has been designed to enable prospective students to self-assess their readiness to study engineering and to use their personalised feedback to inform their career decision making. This may include accessing extra support for study and skills development or seeking careers support to explore the engineering profession. They will be able to determine their interest and motivation in engineering and better understand factors beyond cognitive skills (e.g., maths and physics) related to success in studying for an engineering degree. For example, feedback from the non-cognitive EngCAT self-tests will help prospective students to be more aware of their individual learning approaches and whether they have the skills and abilities that predispose them to engineering studies. This enhanced self-awareness will enable them to seek support where needed and to better manage their learning so that they are well prepared to transition into their engineering program and to then successfully progress through the program.

Chapter 4: Dissemination of Project Deliverables

The project team understood the importance of disseminating information about the project and the deliverables from the start. The team used regular newsletters and conference workshops and papers to inform the engineering education community about the project and EngCAT. It also linked with relevant careers advisor groups and divisions of Engineers Australia to keep them informed about the project.

This chapter describes the dissemination activities undertaken to date and those planned beyond completion.

Project Communication and Dissemination Strategy

The project team continually reviewed the initial dissemination plans as the project progressed. The project leader and project manager communicated regularly with the team and reference group to refine project goals, methodology, and outcomes. The project team identified key stakeholder groups, including engineering professionals in industry, heads of engineering schools and engineering academics, national engineering bodies and/or associations, and careers networks.

Given that the project partners were geographically dispersed they primarily communicated via regular email. This was supplemented by face-to-face project team meetings, alternating between partner universities in Sydney and Brisbane, to build team cohesion. At least one representative from each partner university participated in every team meeting. In addition, a road trip by the project leader and project manager to all partner universities enabled further discussion of project processes and outcomes relevant to the local university context. The team set up a Dropbox folder to share information and resources. Links to a project website were established to deploy Get Set for Success Quiz at each partner university.

The project team invited national experts in engineering and higher education to be in the project reference group. They were chosen for their diverse experience, knowledge and skills relevant to the engineering profession, and included representation from the higher education careers sector. The reference group provided valuable support and viewpoints. Group members were champions of the project who informed their relevant communities of the project aims and deliverables. The leadership team twice met face-to-face with the reference group – at the beginning and towards the end of the project – and also met via Skype at the half way point. In addition, the leadership team kept the reference group and broader community of engaged stakeholders up to date via regular project newsletter and/brochure distributions and conference presentations. More recent newsletters included a link to a video clip explaining the relevance of feedback of the non-cognitive quiz to engineering students and provided an update on the prototype EngCAT website. The project team also disseminated information about the project to their local communities via stories in various university communications and/or local newspapers.

Project Evaluation

A project evaluator with exceptional experience in the engineering discipline was secured early in the project. The project leadership team met with the evaluator to identify and detail the critical success factors against which the project was to be evaluated and then regularly monitored progress against these factors. The evaluator was kept informed of project outcomes and participated in all reference group meetings. The evaluator also met separately with the project leadership team on various occasions to discuss project management and progress. The evaluation report is available in Appendix C.

The Sustainable Deployment of the Get Set for Success Quiz

The data gathered from deploying the Get Set for Success Quiz across the five partner universities will enable the project team to conduct longitudinal research into the profiles of engineering students beyond the life of this project. The project team members agreed to come together again in three to four years and track the academic progress of the 2012 and 2013 cohorts to determine the key predictors of academic success (including GPA, retention and progression) in the long term.

In the short term, the Get Set for Success cognitive quiz remains available for deployment at the current partner universities. A select group of team members have an interest in refining the cognitive quiz and rolling it out more broadly at other institutions. This will involve developing a strategy to make a refined version of the cognitive quiz easily accessible to all Australian and New Zealand universities from 2015. It will also require establishing a new project team and, to avoid copyright issues, developing a new set of cognitive items.

The Get Set for Success non-cognitive quiz will continue to be available via the EngCAT self-tests. Further work to refine the IMSE is planned.

The Sustainable Deployment of EngCAT

The project team developed a prototype Engineering Career Appraisal Tool (EngCAT; http://engcareer.wordpress.com/) based on key findings identified from the Get Set for Success Quiz analyses. Cognitive skills like maths and physics were shown to predict academic success in first year engineering, however, non-technical skills such as a keen interest in engineering and strategic learning were also important. It was therefore important that EngCAT focus on helping prospective students self-test these non-technical skills to help them develop an informed study plan and experience success in their first year studies.

The prototype EngCAT was disseminated to stakeholders in the engineering education community and broader higher education and careers sectors via project newsletters and email communications and other professional development workshops. Stakeholder feedback on the prototype EngCAT informed refinements made to EngCAT to enhance overall quality, user friendliness and value of the website in informing career decision making of prospective engineering students. The updated EngCAT website is available via http://engcat.usq.edu.au

EngCAT is an online self-assessment and career advisory tool for prospective students considering a career in engineering. It is also a valuable information source for careers advisors and/or parents. It is aimed at year 10 high school students who are making career and subject choices but may also be used by other high school students and by people considering a career change.

EngCAT is an online "one-stop shop", providing prospective students with information about the profession, entry requirements and pathways, and study and career options. Prospective students can self-assess their readiness to study engineering. They can self-test their interests and skills in engineering via the newly developed Interest and Motivation for Studying Engineering (IMSE) scale, and better understand the relevance of non-cognitive factors – like strategic learning – found to be related to success in first year engineering. Individuals who complete the EngCAT self-tests will receive personalised feedback about their:

- Personality profile;
- Individual learning approaches; and
- Whether they have the interest and skills that predispose them to engineering studies.

Prospective students can then use this information to inform their career decision-making processes, including:

- Year 10 high school students' selection of subjects to study in years 11 and 12;
- Year 11 and 12 high school students' refinement of subject choices or selection of an alternative pathway into university; and
- Mature age students can identify a pathway to their chosen engineering career, based on their existing education qualifications and/or work experience.

The individual feedback from the EngCAT self-tests will enable prospective students to identify knowledge gaps that might impact on their progress. This enhanced self-awareness will enable prospective engineering students to seek support where needed and to better manage their entry into the profession.

EngCAT is designed to help the engineering industry to attract students who have the required skill sets but who may not otherwise have considered a career in engineering. Thus, deploying EngCAT on the Engineers Australia website, through high school career adviser networks, and on government career websites, should increase the pool of eligible candidates and help to address the skills shortages many sectors of the engineering industry are currently experiencing.

Dissemination of Project Outcomes

As well as the project newsletters and prototype EngCAT website, the team undertook ongoing dissemination of project approach, processes, and outcomes to reach the broader higher education and careers communities through presentations at relevant national and international conferences and workshops.

In the two years from December 2011 to December 2013, the team presented key project outcomes at six national conference paper presentations and two workshops and three international conference paper presentations, including:

- The 2011 Australasian Association for Engineering Education (AAEE) conference in Fremantle;
- The 2012 AAEE annual conference in Melbourne;
- The 2013 AAEE annual conference to be held at the Gold Coast in December;
- The 2013 Higher Education Research and Development Society of Australasia (HERDSA) in Auckland, New Zealand;
- The 2013 First Year Higher Education conference in Wellington, New Zealand;
- The 2013 European Society for Engineering Education conference in Leuven, Belgium.

Below is a list of refereed publications at these national and international conferences:

Burton, L. J. (2013). Get set, go! Preparing for success in first year engineering. *Proceedings of the First Year Higher Education Conference, 7-10 July, Wellington, New Zealand.*

Burton, L. J., & Albion, M. (2013). Developing a self-report measure of students' interest and motivation for studying engineering. *Proceedings of the 2013 AAEE Conference. Gold Coast, Australia.*

Burton, L. J., Albion, M., Shepherd, M., McBride, W., & Kavanagh, L. (2013). Helping first year engineering students get set for success in their studies. *Proceedings of the 2013 Higher Education Research & Development Association Conference, Auckland, New Zealand.*

Burton, L. J., & Dowling, D. G. (2013). Towards an engineering career appraisal tool for secondary school students. *Proceedings of the 41st SEFI Conference, 16-20 September 2013, Leuven, Belgium.*

Burton, L. J., Dowling, D. G., Kavanagh, L., & Aubrey, T. (2011). Three approaches to determining students' capabilities for studying engineering: Towards a national approach. *Proceedings of the 2011 AAEE Conference, Fremantle, Australia*.

Burton, L. J., Dowling, D. G., Kavanagh, L., O'Moore, L., & Wilkes, J. (2012). Examining first year students' preparedness for studying engineering. *Proceedings of the 2012 AAEE Conference,* Melbourne, Australia.

Wilkes, J., Glen-cross Grant, R., Burton, L., & Albion, M. (2013). Are engineering students' interests and attitudes to study so different to scientists? *Proceedings of the 2013 AAEE Conference,* Gold Coast, Australia.

Members of the project team also presented workshops at the annual conference of engineering education in 2011 and 2012. These workshop presentations are summarised below:

Burton, L. J., Dowling, D. G., Kavanagh, L., & Aubrey, T., McBride, W., & O'Moore. (2011). Using aptitude tests to engage students in engineering. *Workshop presented at the 2011 AAEE Conference, Fremantle, Australia*.

Burton, L. J., Dowling, D. G., Kavanagh, L., O'Moore, L., Aubrey, T., Lowe, D., Wilkes, J., Glencross-Grant, R, & McBride, W. (2012). Developing an engineering career appraisal tool. *Workshop presented at the 2012 AAEE Conference, Melbourne, Australia*.

The project leader was invited to present on the project to the Australian Council of Engineering Deans (ACED) prior to at the AAEE conference in December 2011 and a copy of the final report will be provided to ACED upon completion. In addition, the project leader and select members of the project team disseminated exemplars of EngCAT at relevant interactive professional development workshops for career, VET, and STEM high school teachers.

Further manuscripts reporting project processes and outcomes are currently under preparation for publication in higher education and discipline-based journals. The project leadership team will also disseminate the project's key findings to the established community of engaged stakeholders in the engineering higher education and careers sectors via a final project newsletter.

EngCAT will continue to be hosted by USQ and deployed widely to identify and attract students to engineering, including dissemination via:

- high school career adviser networks;
- government career advice websites;
- websites of Australian universities offering engineering; and
- AAEE on the Engineers Australia website.

Conclusion

Given the key finding that non-cognitive skills help predict academic success in first year engineering studies, a key message for engineering educators is that prospective students must not only be competent in cognitive abilities, they also need to show a keen interest in the discipline and adopt a strategic and/or deep learning approach to achieve success. The EngCAT self-tests are a way to measure those broader skills. For example, the newly developed Interest and Motivation for Studying Engineering (IMSE) scale was specifically designed to measure aspects of these non-cognitive factors – functional creativity, conceptual engagement, organisation, inquisitiveness and self-efficacy – and holds promise as a way for prospective students to self-test their interest and skills prior to undertaking their studies.

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Appendix A: Get Set for Success Cognitive Quiz Student Feedback Items

Has this quiz been useful?
Yes, it gave me an insight into the knowledge that I need for 1st year
Yes, it flagged some things that I have forgotten and need to review
Yes, I feel that this is the beginning of my journey of studying Engineering at the University of Newcastle.
Yes, it made me feel that my needs are being assessed
No, it achieved none of the above

If you are glad you did it, how has it helped?
I'm not glad that I did it at all
I have a better idea of what I know and what I don't know
I feel more confident
I have a better understanding of first year knowledge expectations

Based on the feedback you received, what actions will you take?
Revise my high school notes
Find a relevant text book
Ask someone who knows for help
Do nothing because I did well
Do nothing because I will pick it up during semester

If you did not enjoy doing it, why not?
I haven't disliked doing it at all
It was stressful
It didn't help
I forgot a lot of what I knew during the holidays
It has scared me
I was still in a holiday mood
It was time consuming and boring

Example Get Set for Success Cognitive Quiz Feedback to Students

	USQ Resources	*Other resources*
	Revise your prior learning to ensure a successful transition to university studies	
Mathematics Recommended for the following entry level maths courses: ENG1500 MAT1500 MAT1502	***USQ Online resources:*** ***Visit the Maths and Science Topics homepage*** ***https://www.usq.edu.au/learningcentre/alsonline/mathsci/mathstop*** ***Review and revise the relevant mathematics topics*** - *download study modules from Tertiary Preparation courses, enjoy animated activities, videos and presentations, and complete quizzes.* ***Find out more about USQ maths courses:*** ***https://www.usq.edu.au/learningcentre/alsonline/mathsci*** **These resources will be useful for your studies this year and beyond.**	***Other online resources:*** ***Mathematics Review Manual*** http://www.math.mcmaster.ca/lovric/rm/MathReviewManual.pdf Especially the calculus chapter p. 65 and the trigonometry chapter p. 41. Note that comments on pages (i) and (ii) regarding what will be taught in undergraduate classes refer to McMasters University, not USQ. ***Mathcentre*** http://www.mathcentre.ac.uk/resources_for_category.php?f=1&c=4 A very comprehensive site with resources on nearly every maths topic. It includes online quizzes for you to attempt. http://www.mathcentre.ac.uk/resources_for_category.php?f=1&c=8
Spatial ability Recommended for the following entry level graphics course: ENG1100	***If you had problems with the Spatial Ability questions then you may need additional assistance in the graphics courses. Please speak to your course lecturer or tutor about your results.***	
Physics Recommended for the following entry level courses: ENG1002 ENG1500 ELE1801 CIV1501	***USQ Online resources:*** ***Visit the Maths and Science Topics homepage*** ***https://www.usq.edu.au/learningcentre/alsonline/mathsci/mathstop*** ***Review and revise the relevant Science topics*** - *download study modules, enjoy animated activities, videos and explanations* **These resources will be useful for your studies this year and beyond.**	**Online resources** Go to http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html Search topics for information for the relevant Questions For Q55 see http://www.physicsclassroom.com/Class/circuits/u9l3c.cfm
Chemistry		Go to http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html For Chemistry questions look under “Connections to”, and select Chemistry Select the topic area on the diagram to the left for Heat & Thermodynamics
General USQ Resources	• Read your Course Specifications, carefully noting the learning objectives, the topics to be covered, and the assessment details. • Visit The Learning Centre: *Online:* https://www.usq.edu.au/learningcentre 1. *On-campus* At Toowoomba, Springfield, or Fraser Coast campuses. • Visit StudyDesk regularly • Read all emails • Ask questions in class and /or online • Discuss course problems with your course lecturer or tutor • Discuss enrolment and other issues with your Program Coordinator • Contact Faculty administration for administrative problems **Seek help when you need it!**	

Appendix B: EngCAT Self-Tests

Approaches and Study Skills Inventory for Students (ASSIST)

Source: Retrieved from http://www.etl.tla.ed.ac.uk/questionnaires/ASSIST.pdf

The next part of this questionnaire asks you to indicate your relative agreement or disagreement with comments about studying. Please work through the comments, giving your immediate response.
Try not to use "Unsure", unless you really have to, or if it cannot apply to you or your learning.
Please indicate your relative agreement or disagreement with these comments about studying.

	Disagree	Disagree somewhat	Unsure	Agree somewhat	Agree
I manage to find conditions for studying which allow me to get on with my work easily.	○	○	○	○	○
When working on an assignment, I'm keeping in mind how best to impress the marker.	○	○	○	○	○
Often I find myself wondering whether the work I am doing here is really worthwhile.	○	○	○	○	○
I usually set out to understand for myself the meaning of what we have to learn.	○	○	○	○	○
I organise my study time carefully to make the best use of it.	○	○	○	○	○
I find I have to concentrate on just memorising a good deal of what I have to learn.	○	○	○	○	○
I go over the work I've done carefully to check the reasoning and that it makes sense.	○	○	○	○	○
Often I feel I'm drowning in the sheer amount of material we have to cope with.	○	○	○	○	○
I look at the evidence carefully and try to reach my own conclusion about what I'm studying.	○	○	○	○	○
It is important for me to feel that I'm doing as well as I really can on the courses here.	○	○	○	○	○
I try to relate ideas I come across to those in other topics or other courses whenever possible.	○	○	○	○	○
I tend to read very little beyond what is actually required to pass.	○	○	○	○	○
Regularly I find myself thinking about ideas from lessons when I'm doing other things.	○	○	○	○	○
I think I'm quite systematic and organised when it comes to revising for exams.	○	○	○	○	○
I look carefully at teachers' comments on course work to see how to get higher marks next time.	○	○	○	○	○
There's not much of the work here that I find interesting or relevant.	○	○	○	○	○
When I read an article or book, I try to find out for myself exactly what the author means.	○	○	○	○	○
I'm pretty good at getting down to work whenever I need to.	○	○	○	○	○
Much of what I'm studying makes little sense: it's like unrelated bits and pieces.	○	○	○	○	○
I think about what I want to get out of this course to keep my studying well focused.	○	○	○	○	○
When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.	○	○	○	○	○

The next part of this questionnaire asks you to indicate your relative agreement or disagreement with comments about studying. Please work through the comments, giving your immediate response.
Try not to use "Unsure", unless you really have to, or if it cannot apply to you or your learning.
Please indicate your relative agreement or disagreement with these comments about studying.

	Disagree	Disagree somewhat	Unsure	Agree somewhat	Agree
I often worry about whether I'll ever be able to cope with the work properly.	○	○	○	○	○
Often I find myself questioning things I hear in lessons or read in books.	○	○	○	○	○
I feel that I'm getting on well, and this helps me put more effort into the work.	○	○	○	○	○
I concentrate on learning just those bits of information I have to know to pass.	○	○	○	○	○
I find that studying academic topics can be quite exciting at times.	○	○	○	○	○
I'm good at following up some of the reading suggested by teachers.	○	○	○	○	○
I keep in mind who is going to mark an assignment and what they're likely to be looking for.	○	○	○	○	○
When I look back, I sometimes wonder why I ever decided to come here.	○	○	○	○	○
When I am reading, I stop from time to time to reflect on what I am trying to learn from it.	○	○	○	○	○
I work steadily through the term or semester, rather than leave it all until the last minute.	○	○	○	○	○
I am not really sure what's important in lessons so I try to get down all I can.	○	○	○	○	○
Ideas in course books or articles often set me off on long chains of thought of my own.	○	○	○	○	○
Before starting work on an assignment or exam question, I think first how best to tackle it.	○	○	○	○	○
I often seem to panic if I get behind with my work.	○	○	○	○	○
When I read, I examine the details carefully to see how they fit in with what is being said.	○	○	○	○	○
I put a lot of effort into studying because I'm determined to do well.	○	○	○	○	○
I gear my studying closely to just what seems to be required for assignments and exams.	○	○	○	○	○
Some of the ideas I come across on the course I find really gripping.	○	○	○	○	○
I usually plan out my week's work in advance, either on paper or in my head.	○	○	○	○	○
I keep an eye open for what teachers seem to think is important and concentrate on that.	○	○	○	○	○
I'm not really interested in this course, but I have to take it for other reasons.	○	○	○	○	○

International Personality Item Pool Scoring Key

Source: Retrieved from http://ipip.ori.org/

Extroversion

Positively keyed items

Am the life of the party (1)
Feel comfortable around people (11)
Start conversations (21)
Talk to a lot of different people at parties (31)
Don't mind being the center of attention (41)

Negatively keyed items

Don't talk a lot (6)
Keep in the background (16)
Have little to say (26)
Don't like to draw attention to myself (36)
Am quiet around strangers (46)

Agreeableness

Positively keyed items

Am interested in people (7)
Sympathize with others' feelings (17)
Have a soft heart (27)
Take time out for others (37)
Feel others' emotions (42)
Make people feel at ease (47)

Negatively keyed items

Feel little concern for others (2)
Insult people (12)
Am not interested in other people's problems (22)
Am not really interested in others (32)

Conscientiousness (Detailed)

Positively keyed items

Am always prepared (3)
Pay attention to details (13)
Get chores done right away (23)
Like order (33)
Follow a schedule (43)
Am exacting in my work (48)

Negatively keyed items

Leave my belongings around (8)
Make a mess of things (18)
Often forget to put things back in their proper place (28)
Shirk my duties (38)

Emotional Stability (Relaxed)

Positively keyed items

Am relaxed most of the time (9)

Seldom feel blue (19)

Negatively keyed items

Get stressed out easily (4)
Worry about things (14)
Am easily disturbed (24)
Get upset easily (29)
Change my mood a lot (34)
Have frequent mood swings (39)
Get irritated easily (44)
Often feel blue (49)

Openness to Experience (Creative)

Positively keyed items

Have a rich vocabulary (5)
Have a vivid imagination (15)
Have excellent ideas (25)
Am quick to understand things (35)
Use difficult words (40)
Spend time reflecting on things (45)
Am full of ideas (50)

Negatively keyed items

Have difficulty understanding abstract ideas (10)
Am not interested in abstract ideas (20)
Do not have a good imagination (30)

Interest and Motivation for Studying Engineering (IMSE) Scale

1	I like to know how things work.
2	I like to know how things could work better.
3	I have high standards for academic work.
4	I love maths.
5	I have pictured myself being successful in my chosen profession.
6	I am confident I have the ability to learn the necessary concepts to be successful in my studies.
7	I like to design and build things.
8	I like to find solutions to practical problems.
9	I usually sketch a diagram to start working out a problem.
10	I have an enquiring mind.
11	I want to have a job that could change the world.
12	I want to adapt systems so that they are more sustainable and have less environmental impact.
13	I am confident I have the ability to learn the necessary communication skills to be successful in my studies.
14	I enjoy working as part of a team.
15	The first step I would take when solving a problem is to define the problem.
16	I am open to new ideas.
17	I am confident I can complete my studies.
18	Chemistry is fascinating.
19	I am a creative thinker.
20	I will persist with a problem until I solve it.
21	I like communicating my ideas to others.
22	I have academic goals.
23	Physics is fun.
24	I am a logical thinker.
25	I like to manage projects.
26	I like to focus on details.

Example Get Set for Success Non-Cognitive Quiz Feedback to Students

Thank you for participating in the Get Set for Success Project.

Your scores on the Learning Approach Questionnaire and the Personality Inventory are outlined below:

Approaches to Learning

Deep Approach	……
Strategic Approach	……
Surface Approach	……

The feedback below will help you understand and reflect more effectively about your study strategies.

Learning Approaches Feedback

Your learning approach is a result of personal preferences and a number of teaching and learning factors. While the demands of study at tertiary level means that students employ strategies from deep, strategic, and surface approaches, research has shown that students who seek to understand the material and complement the **deep** approach with use of **strategic** elements are more likely to be successful in their academic endeavours than those who adopt a surface approach.

Deep Approach

Scores range from 16 to 80. Higher scores (61-80) suggest you use more of the behaviours of a deep approach to learning. Scores of 41-60 are moderate while scores of 16-40 are low. Consider where your score places you.

Simply stated, deep learning involves the critical analysis of new ideas, linking them to already known concepts and principles, and leads to understanding and long-term retention of concepts so that they can be used for problem solving in unfamiliar contexts. Deep learning promotes understanding and application for life.

The deep approach to learning involves seeking meaning in study material with an intention to understand ideas yourself and means that students:

- Try to make use of the knowledge they acquire
- Relate new ideas to previous knowledge and experience
- Look for patterns and underlying principles
- Check evidence and relate it to conclusions
- Examine logic and argument cautiously and critically
- Are aware that their understanding is developing while they are learning
- Are actively interested in the course context

Strategic Approach

Scores range from 20 to 100. Higher scores (81-100) suggest you use more of the behaviours of a strategic approach to studying. Scores of 51-80 are moderate while scores of 20-50 are low. Consider where your score places you.

The strategic approach to learning involves reflective organising with an intention to achieve the highest possible grades and involves:

- Putting consistent effort into studying
- Managing time and effort effectively
- Finding the right conditions and materials for studying
- Monitoring the effectiveness of ways of studying
- Being alert to assessment requirements and criteria
- Gearing work to the perceived preferences of lecturers

Surface Approach

Scores range from 16 to 80. Higher scores (61-80) suggest you use more of the behaviours of a surface approach to learning. Scores of 41-60 are moderate while scores of 16-40 are low. Consider where your score places you.
Lower scores on this approach are more favourable than higher scores.

The surface approach to learning involves reproducing study material with an intention to cope with course requirements and involves:

- Treating the course as unrelated bits of knowledge
- Memorising facts and carrying out procedures routinely
- Finding difficulty in making sense of new ideas presented
- Seeing little value or meaning in either courses or tasks etc
- Studying without reflecting on either purpose or strategy
- Feeling undue pressure and worry about work

Personality Inventory Feedback

FIVE FACTORS INFLUENCING WHO YOU ARE
Each of the following five personality factors reflect aspects of who you are. Your personality profile below indicates the relative influence of each factor in shaping your personality. It is important that you take into account all of the five factors in combination, rather than any one factor alone. Remember, there are no right or wrong profiles; we are all unique individuals. The profile is intended to help you better understand aspects of your personality to enable you to consider how you are likely to behave in the organisation and how your personality can shape the way you communicate with others.

Personality Traits

Extrovert <##extravGraph##> Introvert
Agreeable <##agreeGraph##> Tough minded
Detailed <##conscGraph##> Flexible
Relaxed <##neurotGraph##> Sensitive
Creative <##opennGraph##> Conventional

It is assumed that you have a natural tendency for each of the personality factors, and your score shows where you fit on the continuum for each factor. For instance, if you score toward the Extroverted end of the continuum, you would have a natural preference to be open and talkative and find the company of others stimulating. In contrast, if you score toward the Introverted end of the continuum you gain your energy from within, so may prefer to work on your own. If you score in the middle, you would tend to fluctuate between the two extremes of this factor. Click on the factors for a more detailed outline of each.

EXTROVERT

Tendencies
- Extroverts enjoy being with people and actively seek out the company of others.
- Extroverts are open and talkative and find the company of others stimulating.
- Extroverts possess high levels of energy and are action-oriented.
- Extroverts are less inclined to consider or reflect on their thoughts and feelings as they tend to be more focused on the outside world.
- Extroverts are less anxious about receiving negative feedback.
- Extroverts enjoy attention.

In the Organisation
Extroverts tend to have excellent interpersonal skills, be enthusiastic and persuasive so they can make natural leaders. They tend to possess the skills to bond teams together, to effectively communicate ideas and the ability to persuade others to adopt them. In both a social or workplace setting, extroverts are likely to say ‘yes’ to new ideas or proposals so, combined with their communication abilities, extroverts can be powerful forces for change within an organisation.

Extroverts tend to require constant stimulation and can become bored very quickly in

routine tasks. This will affect concentration levels and consequently the quality of work in these tasks. Extroverts thrive in environments where they have a variety of responsibilities. The challenge of meeting new and different responsibilities stimulates the extrovert and maintains their attention and focus.

Extroverts tend to enjoy a fast pace and are active (like to be doing something) which can sometimes lead them to act impulsively. Impulsive action can be appropriate in some circumstances; however impulsive acts can also result in outcomes which are adverse for an organisation.

Extroverts draw their energy from other people so the more people they are around, and the longer they are around them, the more stimulated they tend to be. Extroverts like to talk and assert themselves so when working in a team, extroverts need to ensure they do not dominate conversations, but also listen attentively to others and draw on the ideas and expertise of fellow group members. This will ensure extroverts do not alienate fellow team members and miss viable ideas. Extroverts are unlikely to work well on their own for long periods of time. Extroverts gain their energy by being around other people so they are unlikely to work at their best in isolation.

Communication and Teamwork
In order to concentrate on routine or boring tasks and complete them satisfactorily, outgoing individuals may need to try very hard to overcome their tendency to be distracted. This may require them to make the task competitive in some way, for example, they may try to complete it in the fastest possible time.

When working in a team, outgoing individuals will prefer to have a variety of different responsibilities that they can complete quickly, rather than be given one long task.

Outgoing individuals need to try to bring some balance to their natural tendency to dominate. It may be best for them to put in a special effort to make the others in their team feel comfortable and to listen to others' ideas.

INTROVERT

Tendencies
- Introverts gain their energy from within, so they may prefer to work on their own. As they do not require external stimulation, they are able to concentrate on tasks for long periods of time.
- Introverts like to work with ideas and thoughts. They are interested in the facts and reasoning behind their work and often develop ideas by themselves after spending time reflecting on them.
- Introverts can be very active and energetic but generally prefer a calm environment.
- Introverts can be shy in the company of other people, especially strangers.
- Introverts tend to be quiet, and prefer not to be in the limelight.
- Introverts are deliberate and often reflect on things. They are consequently unlikely to act impulsively.
- Introverts tend not to be overly talkative and so may come across as slightly reserved in

a group situation. They are likely to have a small group of very close friends. In the company of people they know well, introverts are likely to be more open and talkative.

In the Organisation
Introverts are often deep thinkers who make valuable contributions in the workplace because they take the time to really consider issues and ideas. Introverts like to think before they talk so while introverts may not say a lot, when they do say something, it is usually worth listening to.

Introverts like their own space and do not need constant interaction with others for stimulation. Unlike extroverts, frequent interaction with people can sap the energy of introverts and lead them to feel frustrated. Introverts may work best in environments where interaction is less frequent and they are able to concentrate for long periods of time without disruption.

Introverts like to think through the implications when presented with new ideas or proposals. Where a decision needs to be made or a vote taken, introverts may prefer to have advance notice of the ideas so that they can consider them calmly before being required to make a decision.

The introverts' tendency to be reserved can mistakenly be interpreted by others as unfriendliness and this may affect their personal and professional relationships.

Introverts can be excellent leaders and communicators. However the effort to play a more extroverted role may be more stressful and demanding for them, as it is not their natural preference. To deal with this stress they may seek a quiet balance in other areas of their lives.

Communication and Teamwork
Introverts are often valued in groups for their perception and clear thinking. Professional workplaces generally require frequent interaction with colleagues and clients therefore by working on their interpersonal and team working skills introverts can successfully build strong professional networks and maintain effective working relationships.

Team structures must also be designed to maximise the contributions that introverts can make. Introverts, given the chance to develop ideas by themselves or in small groups with people they know well, can be great team players.

Introverts may be reluctant to speak in a group/team setting. This should not be interpreted as the introvert having no ideas or nothing to contribute. Introverts may indeed have the best ideas and the most effective solutions to the problems at hand; however, they are not as assertive as extroverts in group environments and may need to consider opportunities to contribute their ideas through alternative mechanisms. For example, introverts may feel more comfortable with written communication, as this gives them the opportunity to sit and reflect before committing their thoughts to paper.

AGREEABLE

Tendencies

- Agreeable individuals tend to be considerate, friendly, generous, helpful and willing to compromise their interests with others.
- Agreeable individuals tend to believe that getting along well with others is important.
- Agreeable individuals have a positive view of human nature most of the time.
- Agreeable individuals tend to believe in fairness and enjoy working in teams.
- Agreeable individuals tend to be patient and let others have a voice in decisions.
- Agreeable individuals tend to be tolerant of others.

In the Organisation

Agreeable individuals can significantly enhance the school vibe because they respect the needs of others, are generous, and generally well-liked. They help to create harmony and enjoyment in their environment and so are often valued by those around them.

Because they want to get along well with others, agreeable individuals can find it difficult to disagree with others and so may be thought of by others as too soft or as giving in too easily. Agreeable individuals may try to avoid fights or disagreements and sometimes this may mean that they will be taken advantage of. For example, they may end up doing the majority of work in a team, or put up with, or not report unacceptable behaviour from others.

In situations that require tough or absolute decisions, for example calling others on their unacceptable actions, the agreeable individual may shy away and have difficulty making these decisions.

Communication and Teamwork

Agreeable individuals are able to relate to the feelings of others and to be genuinely interested in their well-being and this is one of their strengths. Leadership roles however that may require tough decisions to be made, with wide spread impacts on others, may be a challenge for the agreeable individual. It may help the agreeable individual who is a leader to try to make their decisions with their emotions put to one side.

Agreeable individuals may choose to go along with a group decision even though they disagree with it. Their tendency to give in to others for the sake of keeping the peace can sometimes mean that the team does not end up with the best result that they could have. For this reason, agreeable individuals may want to try to develop their ability to express concerns in a manner that does not threaten the harmony of the team. It may help the agreeable individual to realise that a having a different opinion to others does not mean that they will destroy that relationship, in fact, some people appreciate the honesty that comes from a well delivered opposite viewpoint and in this way relationships can be strengthened.

Agreeable individuals are a welcome part of most teams as they are easy going, supportive, and willing to help. Sometimes it may be better for the team leader to discuss matters with agreeable individuals one-on-one so that they will be more comfortable to give their true thoughts and feelings.

TOUGH MINDED

Tendencies

- Tough minded individuals are self-reliant, independent and express strong opinions.
- Tough minded individuals are very determined and will drive through obstacles to achieve objectives.
- Tough minded individuals may place self interest and achievement of objectives above getting along with others.
- Tough minded individuals find it easy to give orders and make clear decisions.
- Tough minded individuals have a dominant personality and may therefore find teamwork challenging.
- Tough minded individuals are capable of dealing with office politics.

In the Organisation

Tough minded individuals can be highly effective in terms of achieving organisational objectives, attaining personal success and promotion. They make their decisions objectively and free of emotion. Consequently, they are capable of making hard decisions. Their approach can sometimes come across as pushy, so peers may perceive them as not caring and being overly ambitious.

Tough minded individuals sometimes forget to consider the well being of others. They may not take a great interest in the personal lives of colleagues and, while they do not intend to be deliberately rude or uncaring, their actions may seem to show indifference.

Tough minded individuals can be overly sceptical of people's motives. This may cause them to be suspicious, unfriendly and they may sometimes be unwilling to cooperate.

Tough minded individuals can be impatient with less-talented colleagues. This can create unrest and feelings of resentment among peers. They can create better relationships within the organisation if they try to become aware of their patience levels and consider the perspectives of others.

Communication and Teamwork

While tough minded individuals are highly driven and can achieve great success in the workplace, their 'crash or crash through' approach can cause upset among colleagues and peers. Over time, tough minded individuals may have a number of achievements to show, but they may need to work harder to create effective relationships. Lack of peer support may hamper their attempts to introduce initiatives which require broad support. It is therefore advised that tough minded individuals ensure they broaden their consultative ability to ensure they are perceived as taking people with them rather than leaving them behind or ignoring them. A few hours harnessing people's thoughts and ideas may be sufficient for tough minded individuals to achieve broad support for initiatives.

Learning not to be overly assertive and pushy in a team environment allows tough minded individuals to get on better with peers and makes it easier for their ideas to gain acceptance. It will allow them to lead a cohesive and supportive team.

Successful tough minded people may need to work hard on developing relationships. It may be easier for them to believe that relationships are not important, but over time they learn they are often the key to success in teams. Tough-minded individuals would be well served to establish rapport with their colleagues (e.g., ask about their weekends, health, etc.) before launching into the purpose of a meeting. This can ensure that tough minded individuals are perceived more positively by their peers and it can potentially help them to be supported by their peers when needed.

When working in teams, tough minded individuals are encouraged to become more tolerant of other less motivated or less talented members, to ensure such colleagues can also contribute to the team.
Concerns expressed to tough minded individuals are likely to be perceived as just another obstacle to be overcome. Concerns should be expressed to tough minded individuals around achieving objectives (e.g.,' I feel the objective could be better achieved by', or 'I am not sure we can achieve this objective because', or 'if we do this now it will help us achieve our objective down the track').

DETAILED

Tendencies

- Detailed individuals prefer a structured approach to work.
- Detailed individuals are reliable and efficient.
- Detailed individuals take a deliberate approach to work and make well thought out decisions.
- Detailed individuals are quality focused and pay strong attention to detail.
- Detailed individuals have a strong sense of duty to the organisation.
- Detailed individuals are keen to achieve.
- Detailed individuals are committed to tasks and will persevere to complete tasks and strive to complete them diligently.
- Detailed individuals are morally upright and principled.

In the Organisation
Detailed individuals are often very reliable, organised and responsible. Detailed individuals know of, and comply with, internal procedures. They are punctual, have clear plans and schedules and meet deadlines.

Individuals with this preference are excellent in roles that require attention to detail, organisation and precision. They may be less suited to roles where imagination and innovation are needed.

Detailed individuals are likely to set clear career goals, discover what needs to be done to achieve these goals, and then develop strategies to achieve them.

Less-detailed people may feel alienated when they are around detailed people, particularly if they are criticised for their lack of organisation.

Detailed individuals can be overly reliant on a plan and not comfortable reacting quickly to new or unforeseen events (e.g., if things do not go to plan detailed individuals may find it difficult to adapt).

The desire of detailed individuals to 'get things right' can lead them to become perfectionists. This may result in excessive work and worry for little or no benefit.

Communication and Teamwork
Their desire for perfection should be balanced with a consideration of time constraints and an understanding that an exceptional job does not need improvement. Detailed individuals may end up modifying things which do not require modification or adding material that is unnecessary. This is an unproductive use of time and may upset peers and jeopardise the achievement of other objectives.

An excessive focus on detail, such as excessive note taking during meetings, may result in detailed individuals missing the broader picture and messages communicated through body language and intonation which are just as important. Detailed individuals need to develop their ability to determine what is important and what isn't important to ensure they do not waste their time and/or miss important information.

Team members working with detailed individuals can help them to better see the big picture by providing them with details. Detailed individuals need to know what the project is, how it is going to be achieved, and the timeframes for achieving it. If thorough detail is lacking, an idea is unlikely to gain the support or respect of detailed individuals.

Detailed individuals have a high need to achieve so they will predominantly look to do the best job possible. Approaching detailed individuals with last minute requests is unlikely to be successful as the detailed individual would question whether it can be successfully achieved in the timeframe available. Thus, when working with detail conscious people, sufficient time must be permitted for them to successfully complete the task.

FLEXIBLE

Tendencies
- Flexible individuals tend to have an informal approach to work and dislike fixed plans, schedules and routines.
- Flexible individuals may not be detail conscious.
- Flexible individuals tend to prefer strategic, big picture thinking.
- Flexible individuals are less committed to formal tasks and tend to dislike paper work.
- Flexible individuals work well in a chaotic environment and are good at multi-tasking.
- Flexible individuals prefer spontaneous environments.

In the Organisation
Flexible individuals are less structured in the way they work. They can be, inventive and have the ability to multi-task. Flexible individuals deal well with change or unforeseen events. They like to keep their options open for as long as possible and will pursue many different ideas before making a decision. As a result, they can come up with a superior option which

others may not have considered. However, they may also put off decisions in order to explore further options, which can make them seem inconsistent and may limit their productivity.

The unstructured tendencies of flexible individuals may lead to their being criticised for being unreliable and failing to follow the rules.

The absence of a clear plan, direction and a deadline may result in flexible individuals being immobilised by the endless exploration of options.

Flexible individuals may have things well in hand and under control but detailed individuals, who prefer detailed plans and schedules well in advance of events or activities, may perceive them as disorganised and question their ability to deliver on objectives.

In the absence of a clear plan, flexible individuals may easily become distracted during a project which requires organised sequences. This can delay a project or mean it is never completed. Consequently, flexible individuals may earn a reputation for being 'scattered' (i.e., their thinking is all over the place) and someone who starts, but does not complete, projects or tasks.

Communication and Teamwork

An unstructured approach is fine if flexible individuals work on their own, however, when working with others, a more structured approach will enable peers to know what has to be achieved, how it is to be achieved, and when it has to be achieved. Without defined details, colleagues and peers can become unsure of what is to be done and the associated timeframes, creating anxiety and tension. Flexible individuals are advised to develop their ability to construct work plans and to set deadlines, enabling them to finalise decisions rather than deferring them indefinitely.

Flexible individuals can be perceived as having little ambition, however, it may reflect their indecision regarding the various options about what it is they want to do and achieve. It would be helpful for flexible individuals to develop their ability to set life goals so that they can focus their energy and talent more productively on achieving these goals rather than continuing to explore different options or waiting for fate to guide the way.

If flexible individuals are also extroverts they may have a number of uncompleted projects. They are encouraged to assess tasks before undertaking them and, once undertaken, focus on completing the task before moving to another.

Flexible individuals are not focused on detail so excessive detail may lose their interest. It may be better to provide flexible individuals with the broader objective of what needs to be achieved and only necessary details. A very rigid timetable of meetings and events may alienate flexible individuals so it may be wise to allow some flexibility with deadlines.

RELAXED

Tendencies.

- Relaxed individuals are calm under pressure.
- Relaxed individuals cope well with change, pressure and the unexpected.
- Relaxed individuals are optimistic and enjoy taking the lead.
- Relaxed individuals are easy going and therefore are not easily upset. Nor are they likely to make decisions based on emotion.
- Relaxed people may sometimes take things too casually and may therefore respond better to deadlines and a little pressure.

In the Organisation

Relaxed individuals feel confident that they can adapt to a variety of situations and are able to work well under pressure and resolve crises effectively.

Although relaxed individuals can calmly resolve issues and problems, and this can be a great strength, their easy going approach can sometimes be perceived as laziness, irresponsibility or them not taking things seriously.

Confidence in their ability may lead relaxed individuals to underestimate the size of tasks and the time needed to complete them.

Communication and Teamwork

Relaxed individuals are comfortable working under pressure and so may be happy to not finish tasks until the last minute. Although this strategy is risky, it may work for individual projects, but it is unlikely to work in a team environment, where at least some members will not feel comfortable working under pressure.

When working as part of a team, the relaxed individual may think of the concerns of others, who may feel that tasks are not achievable, as them being overly negative. This can create a tense team environment. Therefore the relaxed individual would be advised to respond to such comments by taking the time to explain in detail how the current course of action will address requirements and how the task can be completed within the time available.

When communicating with a relaxed individual, concerns about deadlines are best expressed calmly and methodically so that the relaxed individual takes the concern seriously and does not dismiss it as simple negativity.

SENSITIVE

Tendencies

- Despite having potentially enormous talent, sensitive individuals may lack confidence in some of their abilities.
- Sensitive individuals can feel very anxious under pressure (i.e. approaching an assignment deadline, exam period).
- Sensitive individuals may feel unsure of themselves and consequently may be uncomfortable presenting ideas, even though their ideas are great.

- Sensitive individuals may interpret some changes as threatening, and therefore may tend to feel more comfortable in a known situation.

In the Organisation
Sensitive individuals may not react well under pressure so they are unlikely to enjoy an environment in which there are frequent, tight deadlines.

Sensitive people need to feel comfortable in their surroundings to perform well. The more at ease they are, the more likely they are to be productive.

Sensitive people react to the pace and style of their environment. When situations are very stressful this can make them upset and they may react emotionally rather than logically. By becoming more aware of how their environment is impacting upon them and having a more conscious decision-making strategy, they can make better decisions and confront tasks they may have been avoiding.

When constructive criticism is given to sensitive individuals, they may dwell on it and find it difficult to take on board.

Communication and Teamwork
Sensitive individuals find it easier and less stressful if they complete work in advance of due dates. Team members need to be aware of this and ensure tasks are completed well before deadlines. Effort should be made to avoid giving sensitive individuals work to complete with a very short deadline (i.e. requesting work at the last minute).

To communicate constructive criticism to a sensitive individual, care and thought should go into the delivery of it, and it should be prefaced and concluded with positive affirmations about that individual. Sensitive individuals may need to work on accepting constructive criticism and realising that it should be a positive learning experience.

Efforts should be made not to put sensitive people on the spot as they normally feel comfortable in familiar surroundings, with plenty of notice and where they are not the centre of attention.

CREATIVE

Tendencies
- Creative individuals are imaginative.
- Creative individuals think and act in unconventional ways and consequently, are agents of change.
- Creative individuals focus on the future.
- Creative individuals find routines and systems constricting and enjoy challenging the status quo.
- The creative individual has a variety of interests and is intellectually curious.
- Creative individuals tend to be good at thinking on their feet.

In the Organisation
Creative individuals constantly question the existing rules and procedures and consequently develop new and better ways to achieve outcomes. Creative individuals are the people who can develop new products, services or processes, and consequently, add tremendous value to an organisation.

The ideas of creative individuals may be unconventional; consequently, they may be viewed by others as unrealistic because they do not possess their same creative vision.

Creative individuals are valuable because they can see beyond what is the norm and can inspire change.

Communication and Teamwork
Creative individuals are great at "big picture" thinking and looking at issues in a new way. The challenge is in translating those ideas into a practical outcome. The success of creative individuals' ideas may depend on support from conventional thinkers who can help make the ideas happen in reality. As a result, creative individuals may be challenged to learn how to articulate their ideas in a way that can be understood by conventional thinkers.

The ideas of creative individuals should not be dismissed just because they do not conform to the current policies and procedures. Creative individuals thrive in roles in which they are able to explore new and more effective ways of doing things. For instance, some of these ideas could improve organisational efficiency and/or generate new products or services.

CONVENTIONAL

Tendencies
- Conventional individuals prefer to follow rules and procedures.
- Conventional individuals focus on the present.
- Conventional individuals tend to avoid taking risks and are cautious of change.
- Conventional individuals are practical and down to earth.
- Conventional individuals prefer familiarity over novelty.
- Conventional individuals adapt, rather than create, new approaches.

In the Organisation
Conventional individuals enjoy tasks which are straight forward and routine. The focus of conventional individuals is on the here and now, and they seek to complete tasks using the procedures that are available today.

The conservative nature of conventional individuals, and their tendency to focus on the familiar, may make conventional individuals resistant to new ideas and change.

Communication and Teamwork
Conventional individuals will not typically embrace new ideas or change, consequently, it may be more effective to communicate new initiatives to conventional individuals in ways which clearly convey the benefits (i.e. use pictures, diagrams and/or charts to assist conventional individuals to visualise the new concept). It is important to explain to

conventional individuals how ideas will improve on the existing structure or processes.

Conventional thinkers provide a great reality check for organisations. Their perspective is often grounded in the reality of what can actually be achieved. Their views can help identify the practical issues that need to be addressed.

Concluding Remarks

Combining self-knowledge of your preferred learning approaches and personality traits allows you to better tailor your study methods to optimise your learning.

As a student at USQ there are many resources available to you to assist in your studies:

- Student Services provides Peer Counselling, and Career Counselling, details can be found http://www.usq.edu.au/studentservices/
- The library provides research skills tutorials http://libtute.usq.edu.au

We wish you much success in your future studies.

Appendix C: Evaluation report by Gunilla Burrowes

Get Set for Success: Using online self-assessments to motivate first year engineering students to engage in and manage their learning

Final Project Evaluation Report

November 2013

Executive Summary

The Get Set for Success Project has been a two-year funded project that will be completed in November 2013. It was led by Professor Lorelle Burton at the University of Southern Queensland (USQ) and conducted in five partnering universities:

- University of Southern Queensland (USQ);
- University of Queensland (UQ);
- University of New England (UNE);
- University of Newcastle (UoN); and
- University of Technology Sydney (UTS).

Its aim has been to identify key factors that predict successful transition into engineering studies at university and enhancing interest in careers in engineering among prospective students. These research results underpinned the development of a tool that high school students and other prospective students can use to determine their interest and compatibility for doing engineering. This web-based engineering career appraisal tool (EngCAT), has been developed and its website will be made available on a national Level.

To develop this web tool, the Get Set for Success instrument was developed and tested over the two-year project at the five partnering universities. Get Set for Success is an evidence-based tool developed for this project and has become a valuable instrument in its own right. Get Set for Success Quiz can be used by students pre-enrolment to engineering to identify areas of development they can focus on to improve their success in their engineering studies. The instrument incorporates a cognitive quiz focused on mathematics, physics and chemistry abilities and a series of non-cognitive questionnaires that measure students' interest and motivation for studying engineering, personality traits and learning approaches. The project combined several of the partnering universities cognitive tests to develop a single set of questions which potentially could lead to a more consistent tool used by engineering faculties nationally. Individual feedback was given to students immediately on completion of both the Get Set for Success cognitive and non-cognitive quizzes. This information, which was combined with information from student focus groups and then correlated with student results following their first year of engineering studies, informed the development of EngCAT. The

development and deployment of the Get Set for Success Quiz was a major project in itself and consumed the majority of time and resources, particularly in the first stage of the project.

This report will present the evaluation of the project's processes by separating them into management of the project and the project implementation itself and then provide a short overview of lessons learnt.

In summary, I have witnessed a professional and supportive leadership that facilitated a project team that worked collaboratively and allowed an innovative environment for the continual improvement of the project as it has progressed. This has meant that the potential challenges of working across five universities in two states and three regional areas have been well managed through strong leadership and good communications. In addition, the reference group played a valuable role in advising the project team and kept them accountable. I believe the members of the reference group were very well chosen which added significant value to the project.

There have been several operational challenges identified during the project that have been dealt with well and were used to provide input into improving the end product. The approaches used for both the management and implementation of the project, I believe, have been appropriate and well considered. There are also some broader project challenges that will be discussed further in this report.

Overall, the project has been a resounding success. The main tool, EngCAT, has found an appropriate home both for its hosting and for the continual updating and improving of the website, which will be required over time. The secondary tool, the Get Set for Success instrument, is a new tool in its own right. The current partner universities plan to continue to use it as a series of pre-enrolment self-tests and there is potential for ongoing refinement of the tool so that other universities might also access this tool in the future.

The project leadership team focused on regularly disseminating project outcomes as the project progressed and have generated a community of stakeholders in engineering who are highly engaged and will act on the project outcomes. For example, a PVC at a university in New Zealand contacted the project leader following her recent international paper presentation on the project and there is considerable interest and ongoing discussion about how they might embed EngCAT into their program from 2014.

Background

The Get Set for Success project is an exciting and novel project aimed ultimately at encouraging students' interest in engineering and to add to their knowledge and understanding about a career in engineering and engineering related fields. That is, to allow them to make an informed decision about becoming an engineer, which includes being aware of the skills and competencies required to succeed at university and then later in their career. The interactive EngCAT website has been developed for this purpose. The development of this on-line self-assessment tool (EngCAT) was informed by the data, analysis and understandings gained from the results of the Get Set for Success instrument.

The Get Set for Success instrument is a tool which provides first year students with on-line self-assessment quizzes from which they obtain personalised feedback on their current level of knowledge and skills compared with the pre-requisite skill sets and knowledge that are expected of students' entry into engineering programs.

The main aims of the project were therefore to:

- develop an on-line instrument for first year engineering students ,the Get Set for Success Quiz, as a self-reflection tool undertaken prior to the commencement of their studies to help them identify their cognitive and non-cognitive strengths and weaknesses;
- provide individual feedback, and links to resources, for these students so that they can seek early support for any weak areas;
- gain information to inform the development of the EngCAT; and
- develop an interactive website (EngCAT) aimed at supporting engineering career selection advice.

The Get Set for Success instrument development and results analysis has been a major part of the project as it is the outcome of this that has informed the development of EngCAT, which will be used by prospective students from 2014. The project evaluation is therefore focused predominately on the implementation and management of this operation.

Management of Project

Planning

A very simple and effective planning tool (the "One-Page Project Management" tool) was used to develop the project plan and has been followed by the project leader, Professor Lorelle Burton and project manager, Dr Majella Albion. As indicated in that document, the following formal meetings have taken place with some minor adjustments due to the extension of the project:

- **Team meetings** including: the kick off 2-day meeting in November 2011; at AaeE 2011 & 2012; 1-day meetings February 2012, December 2012, August 2013; and individual meetings between the USQ team and the partner university team leaders when opportunities arose. The team meetings consisted of the project management team and a representative from each of the partner universities.
- **Reference group meetings**: 1-day face-to-face meeting in February 2012 and a follow-up skype meeting in November 2012 plus another half day face-to-face meeting in August 2013. The reference group members have been chosen well for their diversity, knowledge and networks related to this project and have provided valuable support and ideas to the project leadership team who have utilised them well.
- **Project leader and manager road trip:** to visit all partner universities, August 2012, although not identified in the main plan was very valuable and provided support as well as the opportunity to gather information to feed into the discussion around changes to the approach needed in the final stage of the project.

As the project evaluator, I attended the two reference group meetings and had five separate meetings with the project leadership team: February 2012, May 2012, August 2012, December 2012 and August 2013. I have been kept informed of progress and involved with project developments as they have arisen. The reference group meetings were well attended and organised. All members were engaged with the project and provided valuable input, which was utilised well by the project leader and team.

I obtained good feedback about the team meetings where there was enthusiastic collaboration across the five partner universities in sharing knowledge and resources. All team members have very

good reputations in the engineering and/or psychology education research area and have many years of experience in the development of teaching and learning resources. This can be partly observed by the publication list provided in the literature review for this project. This combined knowledge, together with the willing collaboration, provided an enormous advantage in developing and producing a very professional set of products. In addition, this allowed the effective use of fewer formal meetings, where the participants believed the frequency was about right when combined with the other communication methods used by the project leadership team.

Forecasting

It is recognised that the project team did put in a very ambitious time plan for two reasons. Firstly, the impact related to the rigid start time (week 1, Semester 1, 2012) to get ethics approval done before Semester 1, 2012 began. This approval was required in all five universities. The fact that this succeeded was due to the lead university (USQ) obtaining their approval quickly and then providing that as a template for the other partner universities. Team members recognised this was very important and useful for the quick response they obtained from their own universities. It must be noted however that at each of the partner universities the ethics approval was required to be done from scratch on their own forms, which is very inefficient from a sector wide perspective and for the individual researchers.

Secondly, the initial 18-month plan did not allow for the analysis of a second year of testing of the Get Set for Success Quiz, or give enough time to use a full year of results to inform the development of EngCAT. The 6 month extension was very important to the project's success.

Agreements

A special mention is required of the complexity and time that surrounds the setting up of the partnership agreements between the universities, when there are several involved. One of the agreements took nine months to finalise, despite keeping track and working on its progress. This takes valuable time away from the leadership team who should be focusing on the project itself. Thus, it is recommended that this be investigated further for future projects with some support or other mechanism put in place at a higher level prior to project start-up.

Communication and Dissemination

The project leader and manager maintained regular contact with the other four universities, which was very important for the cohesion of the project. Also, the project leader and manager did a road trip in early August 2012 to visit all partner universities at the time of student focus groups, which provided support, as well as valuable exchange of ideas and information about changes required in the approach for the Year 2 implementation. In particular, the focus on the timing of implementation of the Get Set for Success instrument and reducing the number of questions in both parts of the questionnaire, led to improved outcomes in its second year of implementation.

At the 2011 AaeE conference, the project leader and team ran a successful workshop that provided a forum to exchange information about the new project. This was well attended and provided a very timely and useful input into the early stage of the development of the Get Set for Success battery of questions. A conference paper was accepted and presented at AaeE 2012 conference in December 2012 and a follow up workshop was attended by academics from other universities who were interested in the project. I attended this workshop and judged the response as very positive with several other universities keen to have access to the Get Set for Success Quiz.

In addition to the formal meetings, a project brochure and newsletter were produced in February 2012 and newsletters again distributed in July 2012 and again in February 2013 to the community of

stakeholders in the engineering higher education sector who participated in the 2011 AaeE workshop and expressed an interest in being kept informed on the project developments. An email with updated progress, targeted at the reference group members, was provided in August 2012 and again in August 2013.

Two other conference papers have been accepted for the AaeE 2013 and three international conference papers have been presented in 2013.

Discussion at the reference group meeting recognised the importance and value of academic papers, but highlighted the need to also promote the EngCAT website in particular, to a broader audience. The project management team have been aware of this need and have organised and presented papers on the project to the Australian Council of Engineering Deans, the Institute of Public Works, and at seminars at UNE, UQ and USQ on careers advice and student transitions. It will be important to have a planned marketing campaign once the EngCAT website has been launched.

Implementation of Project

Outputs – Development of the Get Set for Success Questionnaire

The methodology used to develop the Get Set for Success Quiz is based on solid research foundations and processes and included some pre-existing freely available questions sets that were integrated into the final product. In fact, several of the universities had already been using their own cognitive questionnaire that they had developed for various reasons and applications which led to the need to negotiate the merging of these questionnaires and the addition of the new material developed as part of this project. A very productive meeting provided the foundation of the development of the two questionnaires: Phase 1 focused on cognitive strengths assessing students' maths, physics, chemistry, and spatial abilities; and Phase 2 looked at motivational and attitudinal aspects of the student through questions on personality type, approaches to study skills, and a new scale to measure students' interest and motivation for studying engineering. The project leadership team then developed the final product after some further input.

The Get Set for Success Quiz was broader than those offered previously by any of the partner universities as it included both cognitive and non-cognitive components.

The only section of the questionnaire that had been developed from scratch by the project team, and therefore was untested, was the set of questions related to "Interest and Motivation for Studying Engineering". Drawing on the team manager's expertise in the area of career decision making, and the project team leader and manager, both being experienced in psychological testing, a small pilot was run using the team members and graduate engineering students.

Outcomes – Implementation of the Get Set for Success Questionnaire

The timing of when the Get Set for Success instrument was available to students impacted on the response rate. At the university of Queensland, Phase 1 of the questionnaire was delivered with the enrolment pack and this approach was seen by students to be compulsory even though students could choose whether to allow their answers to be included in the research component of the project or not. The response rate was a high 93.1%. This compared to the other partner universities who invited students to complete the quiz in the first few weeks of first semester, which resulted in variable response rates ranging from as low as 36.6% to 75%.

The difference in response rates based on timing and method of delivery was a very valuable input into the administration of Year 2's implementation. It highlighted some key issues to address for

future developments in general which included: when should students do the questionnaire; should Phase 1 & 2 be combined to make one questionnaire and how can it be embedded in the curriculum at each university. These were challenges for the Project Team for the implementation in Year 2.

It was agreed to revise the questionnaire and, in particular, to take away sections of questions that proved to be redundant during the analysis of Phase 1 of the project. It was agreed to reduce the size of the questionnaire, which meant that students were asked to do both Phase 1 and 2 at the same time. Putting the two phases together did improve the response rate in Year 2.

In addition, the project team incorporated a small number of questions at the end of the Phase 1 quiz, to get feedback from students on their experience in completing the quiz. This showed that, overall, students had found the self-assessment and personal feedback beneficial. The responses were also combined with the results of the student focus groups that further improve the questionnaire itself.

The project leadership team maintained an issues register, which was worked through at project meetings and provided a consistent approach to implement improvements during the project.

Outcomes – Analysis of the Get Set for Success Questionnaire

A very thorough statistical analysis was undertaken on the results of both years of data and these are being reported in conference papers as the results become available. More importantly for this project was that the analysis and results were used to inform the development and content of the EngCAT website, which was the main goal of this project.

A major challenge for the leadership team, which was responsible for the analysis of the combined data, was the timing around obtaining the data from each of the partner universities. Despite the good will and intension of all involved, the results of the surveys from some of the partner universities were submitted late, which added to the pressure on its analysis. Due to peaks in academic demands, which vary from university to university, it would be advised in future forward planning of projects to incorporate these academic pressures in the schedule with agreement from each of the partners.

Outputs – Development of the EngCAT website

The development of the EngCAT website had been delayed due to several issues, however it was able to be developed quickly once structures were in place. The major issues included:

- Changes in personnel in the USQ Careers group;
- Difficulty in getting agreement from a group who would host and maintain the EngCAT website;
- Finding people with the right expertise to develop a professional website that targets high school market sector;
- Timing of obtaining the Get Set for Success quiz data for analysis which was used to inform the structure and content of the website; and
- The need for large amounts of data and links that were required to make this a comprehensive site, which includes information related to all engineering courses in Australia.

Lessons Learnt

- Project definition
    - The development and implementation of the Get Set for Success instrument was a major project in its own right and consumed a significant portion of the first year and a half of the project. This was required as the Get Set for Success data analyses informed the development of the EngCAT website, however there are important opportunities that this self-test tool can offer also on a nationwide basis.
- Project timing
    - Estimating the time it will take to complete the project tasks when operating across many partners and geographic locations is a key issue to consider. The project team experienced considerable delays in finalising the partnership agreements across the five partner institutions and there remained uncertainty regarding the date of release of funds to partner institutions. This prompted the need for the project team to apply for an extension to ensure they had sufficient time to complete the project and meet its deliverables.
    - Consequently, it is recommended that sufficient recognition and allowance be given to the project start-up phase, especially when project commencement is tied to the academic calendar year and involves multiple partners. In particular, the need for ethics approvals and the need for IT services which can be significantly different across each project site deserves due consideration in project planning.
- Involvement of several universities
    - Project planning is paramount when multiple institutions are involved as they work with different academic calendars and often have different technology structures and systems.
    - The project team ensured there were good strategies in place to enable regular communication between partner universities to minimise cost in terms of both time and travel.
- Finances
    - The funding process would benefit from additional guidelines on when the project should commence and when the funds will likely become available for use by the lead institution and/or distribution to partner universities.

Conclusion

In summary, I have witnessed a professional and collaborative approach among the project team and reference group members that has provided a very supportive and innovative environment for the continual improvement of the project as it has progressed. This has meant that the potential challenges of working across five universities in two states and three regional areas have been well managed through strong leadership and good communications. The approaches used for both the management and implementation of the project, I believe, have been appropriate and well considered. Overall, the project has hit its milestones and proceeded according to its revised plan.

There have been several challenges, which have been dealt with well. In particular, the very short lead-time ambitiously planned but well executed by the leadership team at project start-up has been important to the success of the project. This provided a full year of Get Set for Success data that, after analysis, could be used to inform the structure and development of the EngCAT website. There were challenges also with the implementation of the questionnaire in Year 1, partly due to the ambitious start-up period but also because of the differing technology used in each university. This staggered implementation, however, provided input itself into the improved approaches for the delivery in the second year.

This project has been a resounding success with the presentation of the prototype EngCAT website presented at the final reference group meeting in August 2013. The website has still to be tested and advertised, however, it has found an appropriate home and will be linked to AAEE (Australasian Association of Engineering Education) on Engineers Australia Website and via Careers Australia networks.

In addition, the Get Set for Success instrument is an extremely successful outcome in its own right and there is scope for ongoing refinement of the instrument for roll out more broadly across engineering programs nationwide. The results of the Get Set for Success testing across the five partner institutions identified the key predictors of success in first year engineering programs. The important recognition of the non-cognitive factors as key predictors of success beyond cognitive (i.e., maths) abilities means it is important that prospective students engage in various self-tests of interests and motivations for studying engineering, personality, and learning approaches prior to commencing their university studies. An additional outcome in the future will be obtained from the good will of project team members who have agreed to take a longitudinal approach to tracking students' progress, and will come together again in four years to check on key predictors of successful completion and/or graduation.

The Get Set for Success instrument has informed the development of EngCAT and the non-cognitive component will remain available via the EngCAT website. Both these tools are very useful additions to the resources for prospective engineering students to use to determine their suitability to be an engineer, and for engineering faculties and first year engineering students as an instrument to support students' successful transition to engineering studies. Thus, this project has delivered two successful outcomes for the price of one!