White Paper

UNDERSTANDING THE MOTIVATIONAL DRIVERS OF CHILDRENS' CAREER DECISION CHOICES

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ABSTRACT

Over the past 30 years both Governments and industry have attempted, with mixed results, to put in place numerous programs and career intervention activities focused on making the career decision process easier for students. This research was targeted at examining one specific school based career intervention program which set itself the goal of influencing student career decisions toward Engineering.

In 1998, in response to this now widely accepted perception that few young Australians viewed Engineering as a preferred career path, the Re-Engineering Australia Foundation Ltd (REA) began development and implementation of a number of career intervention programs with the goal of encouraging students to take up careers in Engineering. The most well recognised of these is an implementation of the F1inSchools (F1iS) Technology Challenge which was created in the UK in 2003 and first implemented in Australia in 2004. It now runs in 300 schools across Australian and in 33 countries around the world.

F1iS has been designed specifically through its association with F1 racing to attract the intrinsic interests of students. F1iS is based on the fundamentals of Action Learning and utilises role models and industry involvement as motivation modifiers. Anecdotally it was seen as being very successful at influencing the career decisions choices of the students who participate.

The aim of the research was to measure the impact of the F1 in Schools program on the motivation of school children towards a career in Engineering and to investigate the effects of a range of potential factors. The motivational factors which were studied come from two groups. The first of these is the group of general factors which are known to potentially impact on children's career motivation. These include factors related to intrinsic motivation and self-efficacy and the influence of others in the environment of the students. The second groups of factors are the designed elements of the program itself - namely the use of a project-based Action Learning Engineering activity designed to be "cool" through the use of the latest technology and interaction with industry role models and heroes. The research sought to measure the levels of these two groups of factors for the target group of students, i.e. general levels of intrinsic motivation and self-efficacy and influence of others. It also sought to measure the reaction of students to the various elements of the design of the program including any changes in their motivation toward Engineering and whether there were:

1. Any differences in the general motivational factors as a result of participation in the program;
2. Relationships between the program specific elements and the motivation of students towards a career in Engineering and;
3. Differences in the outcomes and relationships between variables for Boys and Girls.

It concludes with a comparison of intrinsic motivation towards the profession of Engineering as a general career against the activities of Engineering involved within the F1 in Schools Program.

The desired outcome of this research is to offer advice to the Engineering profession and industry to aid the development of strategies for attracting students in its direction.

The results of the research confirmed not only that the F1iS program was able to have a significant impact on the career motivations of the children who participated with 64% of Boys and 35% of Girls indicating that Fi1S had influenced a change in their career motivations toward Engineering. The research also provides a foundation for rethinking the way in which we develop interest in Engineering for Boys as compared with Girls.

SOCIAL AND ECONOMIC ENVIRONMENT DRIVING THIS RESEARCH

SKILL SHORTAGES IN ENGINEERING

It has become widely accepted across industry and politics that Australia has been through severe shortages of skilled people. While shortages are not currently perceived to be politically sensitive as a result of the global economic downturn of 2009, it is accepted that as the mining industry comes back on stream to full production the shortage of engineers and scientists will again be magnified.

While these shortages can, to some extent, be related to specific economic booms which generate low levels of unemployment, there has been a universal acceptance by industry and government alike that there is a severe shortage of students completing Engineering at University. Consequentially a need exists for more students to take up the prerequisite subjects at high schools which facilitate participation in Science, Technology, Engineering and Maths (STEM) pathways.

The response by successive Federal Governments to the shortage of Engineers and, for that matter Scientists, has been based on a rhetoric focused on the development of a skilled nation. Within this rhetoric industry was granted a significant leadership role by Government, yet it failed to understand its responsibility, nor take the opportunity to use its leadership position to attract students to professions critical for success. What little that has been done by way of industry developed career intervention programs[1] aimed at attracting students to appropriate professions, has been in the vast majority of cases, ad-hoc and ill structured in terms of the design, implementation or measurement of outcomes. In addition, few if any of these programs have had their design or construction based on fundamental social science research which could add significant validity to the processes being called upon to achieve the required intervention outcomes.

Within the development of a skilled nation lay an ill-defined description of the skills required to achieve this national aim. The industry definition of required skills (employability skills) places an emphasis on the role, definition and measurement of a range of soft skills which are somewhat ambiguous and imprecise. The responsibility for the construction of learning environments to develop these employability skills landed in the lap of the VET systems (Billett, 2004), a system driven by people ill prepared for the task at hand.

Adding further to this environment, during the 1980's, an educational policy convergence between the major political parties toward economic rationalism had both sides of politics becoming particularly responsive to industry spokespersons and economic analysts who advocated that education be restructured according to market principles (Pusey, 1991) (Marginson, 1993) (Seddon, 1999). As a result of this economic rationalism, the ideological imperatives for the development of a skilled nation become way-laid by a big business focus on short term solutions that have shown little, if any, interest in engaging students, teachers or administrators in developing the attractiveness of professions such as Engineering (AIG, 2006). As a result, "Over the past three decades Engineering has suffered a poor profile leading to less interest from high school and university students." (Heydt, Jan/Feb 2003).

[1] Career intervention programs are activities developed specifically to raise the awareness of specific careers, disciplines or subjects with the goal of attracting students to undertake those activity and the prerequisites needed to participate in those careers, disciplines or subjects.

INDUSTRY RESPONSE TO SKILLING – AN AUSTRALIAN PERSPECTIVE

While there has been significant energy within the Australian context to attempt to understand the drivers and influencers impacting the attraction of students to Engineering (Lewis and Vella, 1885, Australian Committee on Technical and Further Education. and Kangan, 1974, Government, 2006, AIG, 2006, Raison, 2005, Initative, 2001, Govenment, 2001, DEST, 2005, Engineers-Australia, 2004, Maquarie-University, 2005, Australian-Government, 2001) few of the organisations involved in these studies have had a direct involvement in designing or developing intervention programs to meet the goals they have identified.

Most of the student-focused career intervention programs which are currently in place in Australia have historically been developed by individuals, teachers or organisations driven either by personal passion aimed at helping children or alternatively as an activity focused purely on achieving financial reward. Only more recently have programs begun to specifically address the skills shortage issue. In most cases the outcomes, whether intentional or not, have all had an impact on increasing awareness of Engineering for those who participate in the activities but are having very little impact outside the environment surrounding the participants.

More recent activities designed specifically to address the shortage of students taking up STEM subjects which include, for example, the Science and Engineering Challenge by Engineers Australia, the activities of Re-Engineering Australia Foundation's F1inSchools challenge and the Formulae SAE challenge by the Society of Automotive Engineers have had a much broader focus on increasing the level of awareness of specific professions and prerequisites. Further intervention programs and activities with similar broad goals are currently under development by The Australian Academy of Technological Sciences and Engineering (STELR Project), The Warren Centre for Advanced Engineering and a number of the State Governments.

Within the United Kingdom this historical passion-driven development of intervention programs has also given rise to a plethora of programs, each with its own set of goals and key performance indicators (KPI's) but with little common focus. Recently, within the UK there has been an attempt to bring together and recognise the programs that exist under a single banner of a "Technology Learning Grid (TLG)" which unfortunately is little more than a catalogue of programs. The recognition provided by this process has not taken the next step of aligning the goals and KPI's of each of these programs to those of the national goal of educational development.

In Australia, programs such as the F1inSchools (F1iS) are attempting to bring structure to the process of developing effective career intervention programs which are aligned to more than passion or reward alone. In this regard, the F1iS program has proven to be highly successful and is now seen by many companies and government bodies as a critical component of industry/student engagement strategies[2].

[2] Federal Government's Defence Materiel Organisation has chosen F1iS as one of its 14 key strategies to attract students to defence industries.

RE-ENGINEERING AUSTRALIA FOUNDATION LTD

INTRODUCTION

In 1998 a group of like-minded people and organisations from industry and government came together to establish the Re-Engineering Australia Foundation Ltd (REA). This not-for-profit public company has the single objective of forming a pathway of encouragement, along which school students can progress, with each step adding to their interest and understanding of Science, Technology, Engineering and Maths (STEM).

The outcomes achieved by REA to date have far surpassed the initial expectations of the founders, with incredible stories of success around many schools and individual students. The programs of REA provide a unique research platform in that they bring together Action Learning, industry involvement, "cool[3]" projects and industry role models/heroes in an educational environment which has proven, anecdotally, to be very successful in influencing children's career choices. In support of this, many schools involved in the program are reporting enrolment demand in STEM related subjects increasing by 300-400%.

BACKGROUND TO REA

Re-Engineering Australia's (REA) programs are aimed specifically at school-age students and providing technology, motivation and opportunities through a series of structured Action Learning programs. These programs aim to develop employability skills and build interest and understanding of Engineering and manufacturing professions.

One of the most recognised stepping stone programs REA has initiated is the F1inSchools Technology Challenge (F1iS). F1iS is a competition which was first implemented in the UK in 2003 and commenced in Australia in 2004. It is offered to all high schools across Australia; initially aimed at students in years 7 through 10 but often being extended to years 11 and 12. The program focuses on developing the creativity and innovation of high school students through a structured Engineering design project based on the design and development of a model Formula One racing car. The program is linked with the international F1-in-Schools challenge which now runs in 33 countries and has over nine million participants worldwide.

The F1iS project links Schools, Industry, TAFE, Universities and parents in a collaborative and experiential environment focused on changing the metaphor of the education process. In 2011 over 320 secondary schools across Australia, together with numerous Universities and TAFE colleges participated in the program providing a platform for over 35,000 students to actively undertake the challenges each year - with another 350,000 students being exposed to the activities and the outcomes.

The implementation of the F1-in-Schools program in Australia by REA is now recognised as being the fastest growing and global-best-practice example of the program. The incorporation of skills shortages objectives, collaboration and industry links are unique and are now being adopted in many other countries around the world. Annual participation rates by schools in Australia surpass those in any of the 33 other countries involved, including the UK and USA. All of these facts are testimony to the high standard, school suitability and sustainable nature of REA's program implementation methodology. REA has now been involved in the implementation of this program in Canada, France, New Zealand, India, China and Singapore.

[3] The term "Cool" is used as the younger generations' equivalent to the baby-boomers term "Sexy" and refers to items, activities or people who have earned their intrinsic interest and thus promote a desire to be interested, participate or get involved.

The following are some of the awards and recognition REA has achieved thus far:

- Engineers Australia, Engineering Excellence Award NSW 2004 and 2006
- Peter Doherty Smart State Science Award 2005
- Engineers Australia, National Presidents Award 2006
- Warren Centre Medal for Outstanding Contribution to Engineering 2006
- Association of Consulting Engineers (ACEA), Presidents Award for Outstanding Contribution to Consulting Engineering 2006
- Prime Minister's Award for Skills Excellence 2006
- Dassault Systems Global Education Award 2006
- Prime Ministers Award for Excellence in Primary Teaching 2009

REA OUTCOMES, GOALS AND KPI'S

The forces and agendas which influence the career choice decisions of students are many, with complex linkages between the stake holders. The benefits for each of the stake holders can be very different. For the student, the outcomes and benefits being "sold" to them by the differing influencers may not be particularly evident in their eyes due to their stage of social and physiological development.

The competition between industries within the market to attract new entrants into specific career directions is also very intense. Given that Engineering, Science and Mathematics are professions not known for their excellence in self marketing they have to some extent lost their "MoJo"[4] in terms of being cool careers in the eyes of the students. The task at hand of generating interest in these careers has become even more difficult.

To be considered effective REA has set itself the goal of achieving the following Key Performance Indicators (KPI's):

1. The programs should be such that they attract students to participate.
2. The programs must improve the employability skills of the students taking part.
3. The program must increase the attractiveness of STEM subjects.
4. The programs must increase the acceptance of Engineering as a profession of choice.

While there is anecdotal evidence that the F1iS projects have increased the numbers of students electing learning pathways aligned to manufacturing and Engineering, a key outcome of this research is to validate the extent to which these activities are actually meeting the KPI's for attraction to the profession.

In addition to the target KPI's, REA has internal long term goals which are:

1. Forming sustainable partnerships between industries and schools;
2. Promoting collaboration between our cities and country regions in support of innovation;
3. Developing the skills of our children to assure their opportunities for the future;
4. Raising the level of Engineering and manufacturing skills development in regional areas;

[4] MoJo is the essence of being cool. A term bought to significance in the Austin Powers movies.

5. Increasing acceptance of regional communities and regional industry to the level of technology that they can implement in their local environments; and providing a supply of students direct to industry who are able to understand and work with this technology.
6. Creating an understanding in our students of Australia's potential to take a world leadership role in Engineering and manufacturing.
7. Creating new skills training opportunities for young Australians in the field of Engineering technology.

REA PROGRAM DIFFERENTIATION

A fundamental and key differentiator within the REA programs has been the requirement for students to work directly with industry partners in the context of their projects. This results in students seeing a direct relevance between classroom activity they enjoy and the world of work. Another point of difference is the provision of the latest technologies which enable teachers, students and industry to collaborate easily in "smart" classrooms.

Students from schools all over Australia, in both city and regional communities, participate in the program. The Schools are linked through technology into hubs, focusing on the development of collaboration skills. Over the course of the school year, both in their own time and in class with the supervision of dedicated teaching staff, these students follow the Design, Appraise, Make and Test learning steps. This curriculum tests their problem solving skills and encourages innovative and imaginative thinking to create a model vehicle that fits the competition design constraints. The curriculum also encourages an environment of team competition which is aimed at preparing them for participation in a competitive global working environment.

To further facilitate development of collaboration skills, sets of 5-6 schools are joined together in technology hubs in a wheel and spoke format. These technology hubs are provided with current industry technology including a Computer Numerically Controlled (CNC) Router, a Smoke Tunnel, a Wind Tunnel, and world's best Computer Aided Engineering (CAE) software tools including Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) as used by BOEING, Toyota, Mitsubishi, Ford and many of the world's leading organisations for product design and development. The intent of providing industry based technology is to give the students experience with tools that will lead directly to development of skills and capabilities immediately useable in the work environment.

Both metropolitan and rural schools are linked to encourage ongoing collaboration between country and urban students. The students develop a confidence that they have skills and understanding of technology to allow them to continue to live where they like (city or country), following their chosen careers. This also provides capabilities which allow both city and country students to collaborate over distance as is done in business, empowering them to deal with people anywhere in the world.

The "hub" approach to implementing the technology provides a practical, flexible and an integrated approach that addresses the key drivers of skills development by:

- Utilising a mix of schools in hubs selected by industry and geography (including disadvantaged schools, students and parents) thus issues relating to limited access to training and education programs can be alleviated:
- Promoting collaboration between regions so that rural access issues can be overcome preventing internal migration of young adults from rural to metropolitan areas:
- Providing appropriate school participation and training so that low levels of education and employment among Indigenous Australians can be improved:

- Encouraging support from both large and smaller local businesses. Business and marketing skills are integrated into the school support base.

One of the key outcomes for the students is the development of project portfolios which can form a key deliverable in the students' job seeking activities. These portfolios are a testament to the high standards of work produced by the students. They also provide a clearer understanding of the complexity of the project and the quality of the outcomes.

RESEARCH RATIONALE, OPPORTUNITY AND SIGNIFICANCE

The aim of the research was to measure the impact of the F1iS program on the motivation of school children towards a career in Engineering and to investigate the relationships with a range of potential factors which impact career motivation.

With the goal of uncovering pre-existing research which would shed light on student career choice motivation, the initial literature search sought to find linkages between pre-existing theories of learning, choice, social peer environments and interaction with heroes as it relates to the career decision making process. Also for consideration was the impact of the hierarchy which may exist in the process of making career decision choices, e.g. moving from being unaware of Engineering to having some awareness, to having some interest, to higher levels of commitment such as undertaking prerequisite studies of science and maths and to further study in Engineering.

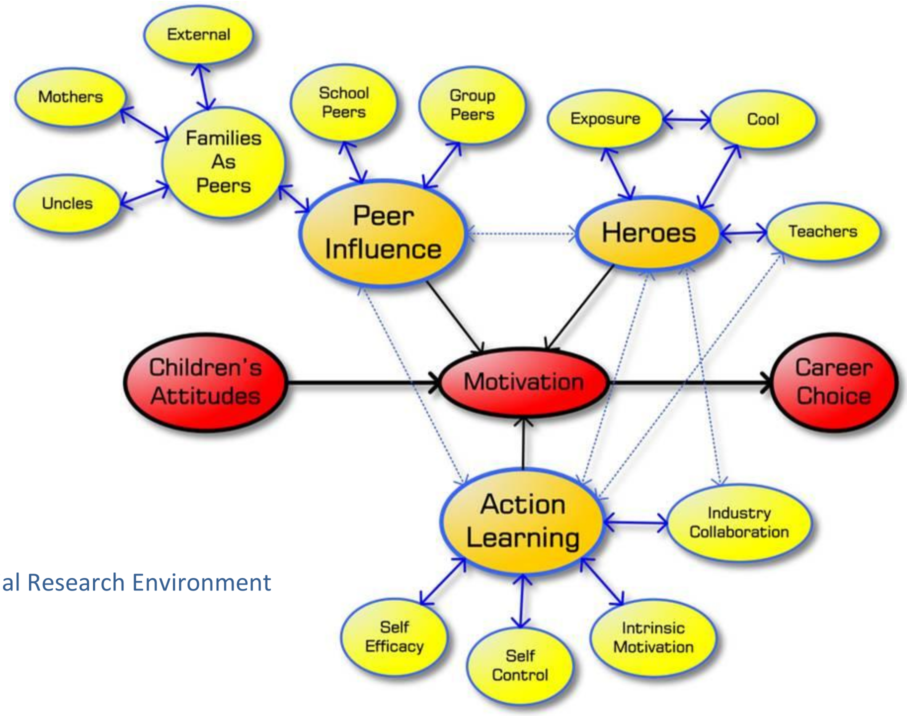

Figure 1 – Initial Research Environment

What became evident from the literature was that key career motivational drivers appear to emanate from a combination of the following:

- environmental peer pressure both internal and external to the school environment, in particular the influence parents have over the career decision process,
- the learning environment's ability to promote self-efficacy and intrinsic interest in a particular direction,
- a student's perceptions of the images Engineering professions offer of themselves and how the delivery of that image fits with the hierarchy of the process of career choice,
- the role of heroes/role models play in the promotion of intrinsic interest and hence their ability to influence career decision choice.

A detailed literature review examined the broad general factors which are known to potentially impact on children's career motivation. These include forms of motivation such as intrinsic and extrinsic, self-efficacy and the influence of others in the environment of the students. The second part of the literature review considers research applicable to elements of the program itself and the development and construction of intervention activities which are focused on bringing about change in motivation in a particular direction. This includes the use of Action Learning environments, the role of heroes and the contribution of industry. A further aspect to consider is the difference between the way in which Boys and Girls respond to these interventions and the general motivation factors.

This research will have a significant outcome if by studying the activities of F1iS we are able to assist Government(s) and industry in the construction of further intervention programs built on this knowledge which can become catalysts for an increase in the number of students choosing STEM educational pathways as a preferred option. It is also hoped that the knowledge developed will provide industry with guidance on how they can influence children to be attracted to their particular industry.

RESEARCH FRAMEWORK

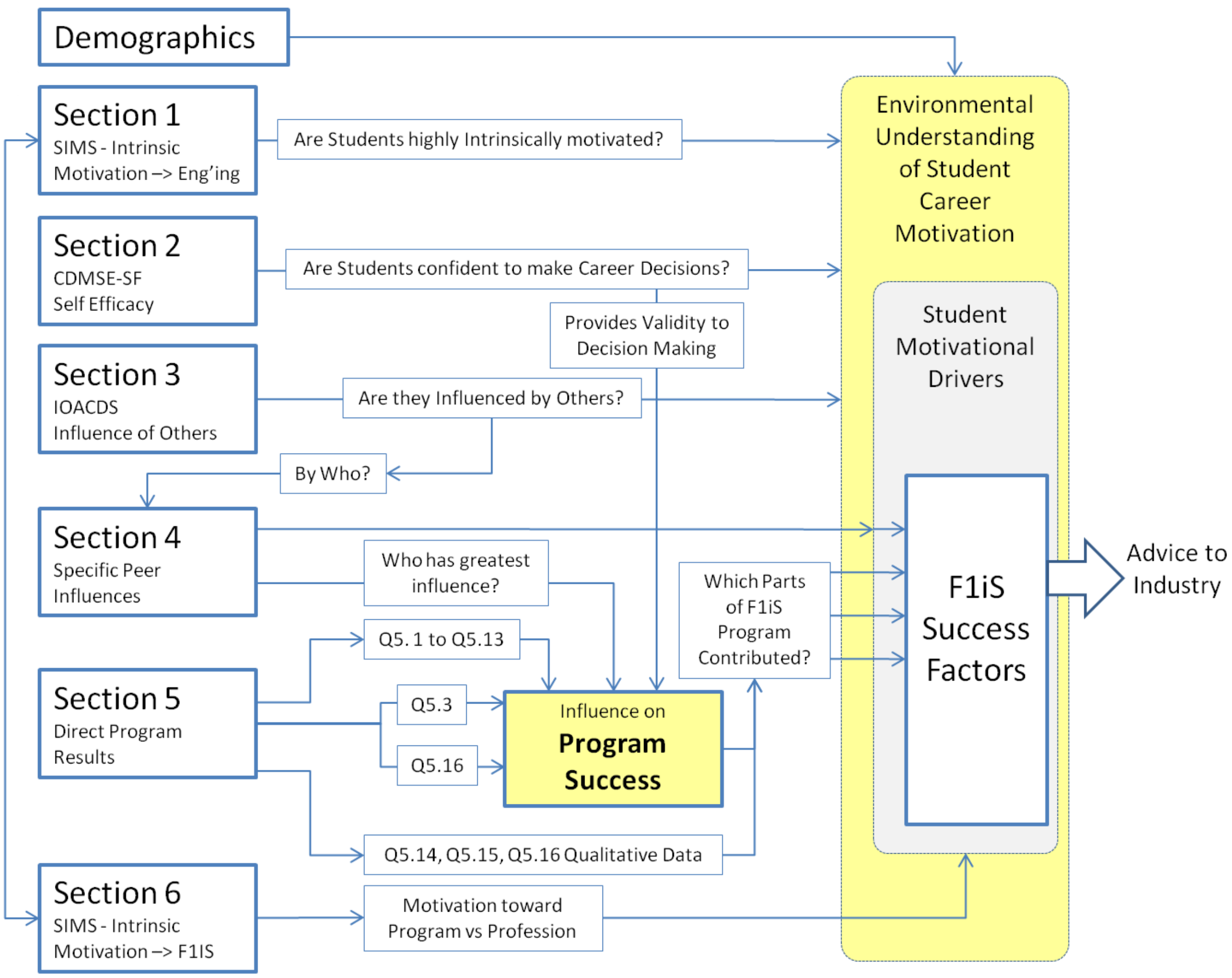

Figure 2 – Research Framework

DISCUSSION OF RESEARCH OUTCOMES

The career decision processes of students are influenced by a complex range of factors which involves them moving beyond the boundaries of the education system into the usually unfamiliar world of work. In addition to the many individual characteristics which act to shape their perceptions, students are subject to the influence of their peers and the aspirations of their parents and many others who exist within their environment. They are also at the age when they are under the influence of numerous genetically initiated changes in their physiologies which impacts their physical and mental capacity and their self-confidence.

When called upon to make career decisions students often find themselves with little preparation for the complex, unstructured and ad-hoc environments in which they can be placed. Cohen's (2003) examination of Existential Theory of Career Choice highlighted that students start to look outside their peer groups and spheres of influence to establish their position in a new adult life and the career decision process becomes a pivot point as they attempt to interpret direction from the many intrinsic and extrinsic signals they are receiving.

This research was focused on examining the effectiveness of one anecdotally successful career intervention program, F1inSchools, which has as its goal, to influence student career choice toward the profession of Engineering. The research goal was to not only measure the success of the program and the reasons behind its success, but also to gather data on the general factors which have been shown to influence career choice in students. An important goal of the understanding developed from the research is to provide advice to those wishing to design further intervention activities and to assist STEM based industries to attract students in their direction.

The students who were selected to participate in the research were drawn from a wide range of socioeconomic and multicultural backgrounds from across Australia. It included students from private and public schools, city and country regions, and from every state in the nation. Given this diversity it is reasonable to assume that the group of students who participated were a broad representation of the Australia high school student population.

In the simplest of terms, participation in the F1iS program has had a very positive influence on student career decision choices, with 64% of Boys and 35% of Girls indicating that Fi1S had influenced a change in their career motivations toward Engineering. This research, however, provides a much deeper insight into the underlying environment of the students and their perceptions on a range of issues related to career choice.

We begin by looking at the three general factors studied in this research before looking at the elements of the program and their influence on student motivation.

INTRINSIC MOTIVATION

Ryan and Deci (2000) highlight that high levels of intrinsic motivation in students translates to a preference and propensity to participate in activities for no other reason than the intrinsic interest it has for them. Intrinsic motivation in students has also shown a clear association with positive decision choice (Lent et al., 2003, Linnenbrink, 2003). The research sought to gain an understanding of these general levels of intrinsic motivation toward Engineering careers and if the F1iS program in any way impacted on this.

Randolf Watt (2004) proposed that intrinsic motivation is more highly visible in the actions of younger children with extrinsic motivation generally more prevalent in older children, yet this research recorded high levels of general intrinsic motivation across all students age groups. The responses to the

Situational Intrinsic Motivation Scale (SIMS) which was used as a component of the research highlighted that the Boys and the Girls both recorded high levels of intrinsic motivation within both the before and after samples and across all age groups. In their response to the fundamental question 'I would be interested in a career in Engineering because I think this Engineering is interesting' 85% of all respondents responded positively to this statement.

The high levels of intrinsically driven motivation towards Engineering as a career amongst the group of students who were surveyed before they participated in the program is an interesting and somewhat surprising outcome. There are, of course, many potential reasons for this high level of intrinsic motivation. One possible explanation is that the presence of the program in the School has stimulated an interest in Engineering and attracts students with this interest to the program. Each school approaches selection of students into the program in different ways. Some schools have the program as a core component in the curriculum so all students will participate. Others initially choose students that they feel would benefit from the program but once a school has been involved for at least 1 year the anecdotal feedback from the teachers is that the students self select based on the intrinsic interest the program generates within the school community. Once it is accepted by the students as being cool the program's growth feeds upon itself. This effect has been seen in many schools where participation in the program has grown from very small beginnings into quite large numbers of students being involved.

While the levels of intrinsic motivation toward Engineering careers did not significantly change due to participation in the program this was not the case in terms of the levels of intrinsic motivation toward the F1iS program. Once the students had experienced the program their intrinsic motivation toward the program showed a statistical significant increase for both Boys and Girls.

The analysis showed a strong connection between the levels of intrinsic motivation in careers and the extent to which students reported that they were more interested in careers in Engineering as a result of their participation in the program (correlation =0.65). This is evidence to support the view that if the students show high levels of intrinsic motivation and their interest is fuelled by activities which are of interest then there is a propensity to influence their career decisions. Once students are lead to experience Engineering activities their intrinsic interest in those activities was also shown to increase.

The analysis of the qualitative data provided further evidence of the connection between intrinsic motivation towards a career in Engineering and the activities of the program. Students recorded "learning about Engineering careers" and "learning that Engineering was fun and exciting" as their two highest responses to those aspects of the F1iS program which changed their perception of Engineering as a career path.

While there was obviously some level of intrinsic motivation which drew the students to participate in the program, it is clear that the program itself was able to increase their general level of interest in a career in Engineering. In latter sections we will examine in more detail the impact specific elements of the program had on developing this interest.

CAREER DECISION SELF-EFFICACY

Self-efficacy makes a difference in how people feel, think and act. There is much within the literature which highlights the interaction between learning and self-efficacy. In particular Nauta (2002) found that the relationship between career interests and self-efficacy is bidirectional or reciprocal and concurred with Lent's (1994) suggestion that interests may influence self-efficacy development in a motivational capacity.

Within the scope of this research it was important to determine if the students who participated had an underlying strength or weakness in terms of their perceived ability to make career decisions. If the students are confident about the career decision process then we can be more confident that any observed positive impact of the program on their career motivations may flow through into a decision to pursue a career in Engineering. A lack of perceived ability to make career decisions would call into question the assumption that any intervention program can infact influence career decision choice.

The Career Decision-Making Self-Efficacy - Short Form Scale (CDMSE-SF) (Betz and Hackett, 1986) used in the research measured an individual's degree of belief that he/she can successfully complete tasks necessary to making career decisions. The CDMSE-SF Scale is based on work originally postulated by Bandura (Bandura, 1977), that self-efficacy is a major mediator of behaviour and behavioural change. Low self-efficacy expectations regarding a behaviour or behavioural domain lead to avoidance of those behaviours, where as increases in self-efficacy expectations should increase the frequency of approach versus avoidance behaviour. Hackett and Betz (1981) in extensions to this research found that an understanding of self-efficacy had considerable utility for the understanding and treatment of career development programs.

The CDMSE-SF Scale uses as a basis for its construction the five Career Choice Competencies developed by Crites (Crites, 1978).

1. Accurate self-appraisal
2. Gathering occupational information
3. Goal selection
4. Making plans for the future
5. Problem solving

Both Boys and Girls groups recorded scales scores above 3.5 on a 7 unit scale for both before and after results of the CDMSE-SF scale which suggests that we are dealing with a group of students with a high underlying self-efficacy toward the career decision process and a belief in their own abilities to go about choosing a career.

Participation in the F1iS program did not appear to change this underlying confidence to be able to make career choices.

INFLUENCE OF OTHERS – PEERS AND ROLE MODELS

As part of the program the students were required to work outside their home and homogeneous peer environments, interacting with role models in a complex business process. It appears that participation in the program may have facilitated different changes in Boys as compared to Girls in terms of their belief in the role others play in the career decision process.

Overwien (2000) highlights that the skills and competencies needed for working life can be acquired in a variety of ways outside the framework of formal education and can actually comprise 70% of all learning in this area. This high level of informal sources of development of our occupational competencies emphasizes the critical role likely to be played by mentors and role models outside of the education process and, consequently, their significant influence on career motivation.

Social persuasion, the encouragement and support of others, forms part of Bandura's (1977) Theory of Perceived Self-Efficacy. Ackalof (1983), Erikson (1977), Taylor (2005) and others also highlight that the influence of role models and heroes, particularly in the early development years, can be profound and this has again been confirmed by this research.

While one section of the research sought to understand the general impact of others on career choice a second sought to examine in much more detail the specific influence of others who exist in the environments which suround the students i.e. parents, mates and peers.

The Influence of Others on Achedemic and Career Decisions Scale (IOACDS) was used to measured two dimensions of the impact of role models on academic and career decisions ie. inspiration/modelling and support/guidance. The results suggest that we are dealing with a group of students who respond to the influence of others. The sub-scale score for inspiration/modelling for both boy and girl groups both before and after could be considered to be moderate to high responses to those influences.

There was, however, some evidence that that the Boys and Girls responded differently as a result of their involvement in the F1iS program in terms of the inspiration/modelling sub-scale. Boys showed an almost statistically significant (p=0.07) increase between before and after in the sub-scale response as compared to no change in the Girls between before and after. There was further, statistically significant evidence of a difference in the impact of the program on the responses of the Boys and Girls to specific peer influences in the questionnaire, particularly in relation to the influence of parents. While the research examined the influence of parents, mates, people they met during the program and people who they considered role models, the greatest significant differences between the Boys and the Girls were recorded against the impact of parents and role models on career choice.

The results clearly show a difference in the Girls group after participation in the program which was the opposite of the Boys. As a result of their participation in the F1is program a high proportion of the Girls (35%) were quite strong in their views that they are less willing to accept their parent's career recommendation just because their parents thought it was a good idea. In contrast, the Boys trended towards a more positive response in terms of their willingness to listen to their parents on issues of career choice. Again while a trend was visible in the plot of the means, the overall statistical test of the means was not significant. Other responses, however, highlighted a statistically significant difference between the Boys and Girls in terms of their willingness to accept the career advice of role models. The Girls showed a decline in their willingness to take the advice of role model between before and after groups and this negative change in attitude was nearly statistically significant in its own right with a p=0.11. This data appears to support the argument that Girls respond less to the influence of role models than do Boys with the difference between Boys and Girls increasing the more the Girls were exposed to the processes involved in Engineering.

The best subset regression analysis of the data highlighted a difference between the predictors of influence in terms of others between the Boys and Girls. This analysis showed for the Boys that the best predictors of the overall response to the program were the following three items:

1. I have met people who have inspired me to take a career in Engineering
2. I would consider the engineers I have met a role models
3. I have a much clearer understanding of Engineering as a career

The similar analysis for the Girls as a group however showed quite a different pattern with the best predictors of the response to the program being:

1. I liked the fact that I used technology used by industry
2. I thought the project was cool
3. I have a much clearer understanding of Engineering as a career

For the Boys there was an overt focus on the influence of role models they had met as part of their involvement in F1iS and an increased understanding of Engineering while for the Girls there was an overt focus on the technology, an improved understanding of the career and an acceptance that that Engineering was "cool" i.e. socially acceptable for them.

For the Girls the first two of these predictors are associated much more with the project itself whereas for the Boys the first two predictors were related to the interaction they had with people they considered to be role models. This appears to contradict the generally held concepts that Girls are attracted to the people issues while the Boys are attracted to the technology. The responses to the qualitative data also supported this hypothesis with a surprisingly larger proportion of the Girls (40%) compared to the Boys (29%) acknowledging that they liked designing and making cars. Anecdotally car design has been considered a boy thing

One point that should be understood is that this research did not measure the numbers of role models the students felt that they interacted with during their involvement in the program and more specifically if those role models were male or female. With Engineering being a male dominated profession the Girls may have interacted with less female role models than male role models. Any discussion about the role gender plays in the importance or influence of a role model will be fraught with complexity. In many of the articles examined in the literature review, the definition students have for role models is one of people who do good things yet at no time was there any indication that Girls equate more so to females role models nor Boys more so to male role models. In terms of this research the decline in the response of the Girls to their mother's recommendation of career choice as a result of participation was the same as their decline in response to their father's recommendation on career choice. Given this fact it would be reasonable to assume that the numbers of male and female role models that the students interacted with during the program had little impact on their overall attitude to the influence of role models no matter the gender. The key point which should be highlighted is the divergence in attitude of the Boys compared to the Girls in terms of their willingness to respond to role models as a result of their participation.

In terms of Neo-Darwinian Rational Choice Theory as it applies to Academic Engagement Norms (Bishop and Bishop, 2007), the response of the Boys might be explained as them responding to an innate capability and desire to learn by experience and by apprenticeship. This result links with the findings of Taylor (Taylor, 2005) who found that employability skills in male youths in Western Australia were found to have been honed by interactions with grandparents, uncles and other role models. It follows that an increased movement of Boys, more so that Girls, into Engineering careers will be achieved by facilitating an increase in interaction between students and adult Engineering role models and by increasing opportunities to learn by apprenticeship from older adults.

Girls, in contrast to the Boys, and prior to their involvement in the program, may have looked to their parents for advice on important issues like career choice. What we may be seeing is that the F1iS experience has provided the Girls with a significantly improved understanding of the processes involved in Engineering careers, thus giving them a clearer understanding of Engineering and their abilities to handle the complexity of Engineering roles. This new knowledge about Engineering careers may now be sufficient for them to feel they have the confidence to make their own career decisions and thus they feel less compelled to take their parents' advice. They now understand the processes of Engineering to the extent that they feel that they are able to make clear career decisions for, or against an Engineering career direction. In support of this the qualitative data highlighted that the greatest outcome from participation in F1iS for the Girls revolved around those items which added to their developed understanding of the activities and complexity involved in Engineering and that Engineering is fun and exciting.

Given that this research was looking to detect the impact of heroes and role models within the activities of the F1iS program, the fact that the students are open to influence by others in terms of career choice adds to the validity of the outcomes of the research. If the students were showing low levels of response to influence by others the possibility of influencing their career choices with the use of role models would be limited. What has become evident is the difference in the extent to which the Boys and Girls respond to the influence of role models and to a developed understanding of the processes involved in an Engineering career. This was not a topic perceived as having relevance when the research began yet has become a key finding of this research.

The Boys clearly seek out human interaction particularly with mentors and role models, whereas the Girls appear to seek out an innate understanding of the complexity of the environment and how that environment fits with their vision for their future direction. For industry to be successful at influencing the career decision of students it will require the development of a different set of selling messages if they are to attract Boys as compared to Girls in their direction.

F1IS PROGRAM IMPACT - OVERVIEW

The foundation of the F1iS program includes a focus on the use of industry heroes as mentors and role models, the use of industry technology to create career relevance and on just being "cool" to attract the interest of school students. Each of these fit with the general factors which drive the development of intrinsic interest as highlighted by Bandura (1977) and others.

In terms of what the students felt they learnt as a result of their involvement in the F1iS program, there were a number of key points of note which were highlighted, particularly in the qualitative responses. The majority of students readily highlighted how much they had learnt about Engineering as a result of the program. In particular what had been learnt about what engineers do, the complexity involved and that Engineering is fun and exciting

By far the biggest response to changing Engineering career perceptions was learning about Engineering careers with 47% of Boys and 67% of Girls recording it as their highest response. Example resposes include: "Engineering is interesting", " there is so much more to Engineering", "leaning about the heaps of types of Engineering", "it's even better than I imagined", & "I now like Engineering". Of particular interest 19% of Boys and 22% of Girls highlighting that learning that Engineering is fun and exciting had the greatest influence on changing their perception of Engineering as a career.

Learning about Engineering and developing an understanding that Engineering is fun and exciting, dominated the overall response of the students and may give some support to the context that prior to particiation in F1iS few students truly understand the profession of Engineering and certainly do not associate the concept of fun and excitement to the profession.

There was also significant interest in using the technology and in particular technology used by industry. 33% of Girls and 34% of Boys highlighted the opportunity to use Industry standard technology as the most important learning outcome from the program. They saw learning technology as both interesting and bringing career relevance to the program. An interest in aerodynamics also rated highly in the qualitative responses of the students. Aerodynamics could be considered a science rather than a technology yet it appeared to attract the interest of many students and would indicate that if given the appropriate relevance, specific sciences are of keen interest to students.

The concepts of learned teamwork, management, communications skills and collaboration with industry were also highlighted by the students as key learning outcomes. Teamwork was highlighted as a key outcome in 11% of responses and in most instances this reference was to the students either enjoying teamwork or recognising the need for teamwork to achieve a result.

BEING COOL

Being "cool" is all about being of interest. Bandura's (Bandura, 1977) Theory of Perceived Self-Efficacy includes emotional arousal (arousal of interest and lack of anxiety in connection with the behaviour) as one of the key elements in the development of self-efficacy and being "cool" fits with this concept. Within a world of Wii's, Twitter, Facebook and Playstation, being sufficiently "cool" is a battle in itself which cannot be fought by those who do not understand the distractive influence of this new technology.

Certainly modern day mythology (Sheahan, 2005) has the Y generation associated with the "I do it because it's there" intrinsically driven attitude to life. There is much popular conjecture as to why the Y generation and those generations which follow are more this way inclined than previous generations. Some argue (Sheahan, 2005) that the Y generation has just been over nurtured and to some extent spoilt, growing up in an environment which allows them to stay socially younger longer and thus, perhaps driven more by intrinsic motivation. It may simply be a result of growing up in an encouraging environment which promotes development of intrinsic motivation. Whatever the reason, attracting the intrinsic interest of students with the goal of modifying their motivations toward a specific career or career intervention program has become much more difficult given the success of our society in creating a plethora of "cool" technological distractions.

83% of the students felt that the F1iS program was "Cool" which confirms that the program was able to break through to the students and place itself clearly in the target range of the students' intrinsic interest. In the regression analysis the Girls placed the fact that they felt the F1iS program was cool as the second highest predictor of their response to the program.

The analysis of the relationship between the measure of intrinsic motivation and the impact of the program showed that the students with higher levels of intrinsic motivation were more likely to be further influenced by activities which can attract their intrinsic interest.

Being cool appears to be a key to the doorway of intrinsic interest. The F1iS program has a number of elements which the students find "cool". These vary from its association with the F1 program, being able to meet heroes such as Michael Schumacher, Jenson Button or Mark Webber[5], being able to use the same tools used by Airbus to design the A380 through to interacting with people from industry who they feel build "cool stuff".

If industry is to develop intervention programs to attract students of this age, those intervention programs need to be sufficiently "cool" to gain the intrinsic interest of the students. Without this "cool" status it becomes difficult for any activity to break through to students and hence provide the access to a diverse range of mentors, role models and heroes who are able to provide guidance and assistance in resolving the priority of the many signals the students are receiving.

USING INDUSTRY TECHNOLOGY

As already highlighted there was significant student interest in using the technology and in particular technology used by industry. The use of industry technology adds to the relevance and vicarious learning (Bandura, 1977) provided by the F1iS program helping to bringing target behaviours that the students associate with a career within realistic boundaries.

A very positive response was shown by the students in both the qualitative and qualitative data to the use of industry technology. Within the quantitative data 86% of the Boys and 71% of the Girls responded positively to the use industry technology. Whilst the response from the Girls overall towards the technology was not as strong as it was for the Boys, this factor is one of the key separators for whether Girls are likely to be interested in a career in Engineering or not.

What was also evident as an outcome of the F1iS program is that students as young as 12 have no problems handling industry level technology such as this. Industry needs to be cognisant of the technological level at which students can operate at a very young age. It should be highlighted that the CAD/CAM technology the students were using was the same technology as use by BOEING, Toyota, Ford and many other leading industry organisations. The school system, historically, has a reputation of

[5] Current F1 Drivers

providing technology to schools which is at a very low level when compared to what is used by industry. It is common knowledge amongst teachers that students are able to learn this low-level technology very quickly, soon becoming bored. Being able to use the same tools as used by industry in the way that has been achieved by F1iS, has provided a platform which has no inherrant limits to the students' scope for learning.

The level of work produced by the students and displayed in their portfolios is a clear indication the students understand how to research projects and careers and are willing to accept and absorb high levels of information. These students are confident and are keen to learn about the benefits and processes involved in specific careers. This is critical information for industry in terms of the development of resources needed to attract students to careers in Engineering. It is essential that industry treats students with a great deal of respect when offering career options and providing students with information about careers. It should not underestimate the level of knowledge students are seeking to help them make career decisions.

Overly simplistic intervention programs which do not understand the importance of this will struggle to attract the intrinsic interest of students and will fail to provide the motivational fuel to promote career selection toward complex professions like Engineering. The need for relevance in the activities undertaken by students appears critical in the process of targeting their interest and the F1iS program is seen by the students as providing career relevance and recognising their capacity to learn.

CONCLUSION

Developmental career theorists such as Super (1996), Ginzberg (1984), Gottfredson (1981), and Vondkracek (Vondracek et al., 1986), have noted the importance of the adolescent years in laying the foundation for future career and educational pursuits. Each of these theorists acknowledges adolescence as an important time in the development of interests, perceptions of abilities, and knowledge of the world of work.

What has become very evident from this research is that, for those students who display high levels of intrinsic motivation toward a career, interventions which are able to further increase their interest in that direction are able to have a significant impact on motivating their career choice. The high levels of intrinsic motivation toward Engineering recorded in the students combined with an activity which rated very highly on their "cool" stakes has resulted in a significant impact on the students with 64% of Boys and 35% of Girls indicating that Fi1S had influenced a change in their career motivations toward Engineering.

While the F1iS program was able to attract the intrinsic interest of the students, the Boys responded to a different set of motivators compared to the Girls. The overt use of Industry involvement within the scope of the project and the subseiquent link to mentors provided a platform for encouragement and support by others (social persuasion). It provided an environment for vicarious learning facilitated by a developed understanding of the processes involved within Engineering tasks which helped bring Engineering careers within realistic achievable boundaries for the students.

The focus on promoting interaction between the students and the Engineering role models had a particularly important impact on the Boys and a lesser impact on the Girls. For the Girls a clear understanding of the processes involved in the profession, particularly in a way that they can relate to, and can make critical career decisions about, appears to have a greater impact on their propensity to include Engineering as a viable career option.

Given a clearer understanding of the motivational drivers of Boys and Girls there exists significant scope for industry to recreate the way it sells itself to students and also the level of intrinsic interest it is able to generate in the profession itself. The current image of the profession of Engineering has historically been developed based on appeasing a set of motivational drivers which work for Boys but not for Girls. The longer term challenge for the profession; if it is to develop intrinsic interest in Girls toward Engineering will be to develop an image of the profession that Girls can relate to, an image that fits with their motivators.

The success of the F1iS program in bringing about motivating change in career choice has highlighted that it is possible to develop intervention programs in Schools which can significantly enhance student employability skills and assist with the achievement of the goals of industry. One only has to look at examples of student portfolios produced as part of their participation in the program to see the outstanding world class work that is produced in the program. The project based learning approach, combined with rich interaction with industry through mentoring and the use of high technology provides useful guidance to the school system on the sorts of learning tasks that will inspire students to achieve their best.

F1iS is as much about bringing career relevance to Engineering as it is about creating an image of fun and excitement around the profession. It has been able to lead students to increase their interests in Engineering career paths. The students who participated are now able to easily make the linkage between industry and the career opportunities which exist and they have come to understand that Engineering is "cool". To quote the students ..."This stuff is cool"... and so should we make all of Engineering "cool".

ADVICE TO INDUSTRY

If we examine the relationship the general public has with professions such as medicine, law and accounting it is certainly well accepted by the community that they can have a personal relationship with their Doctor, with their Accountant and quite possibly even with their Lawyer. Given a general willingness for the public to accept the development of relationships with professions critical to their involvement in society it is paradoxical that few people would consider having a formal relationship with an Engineer. While society trusts the bridges and structures that the engineers build, this does not appear to be sufficient to generate a relationship with the engineers who built these structures.

In addition to the general lack of attachment society appears to have with Engineering there appears an even greater level of detachment by the female gender. Girls have little issue with professions such as accounting, law or medicine where the participation by Girls can be higher than 50% yet for Engineering it can be as low as 2%. This research has shown that correctly targeted interventions can bring about a dramatically change in the number of Girls who have an interest in an Engineering career.

Students currently need significant support to discover just how interesting and exciting the activities of Engineering can be. Learning environments which facilitate an increased understanding of the profession in a way which fits with the different motivational drivers of Boys and Girls will go a long way to providing the guidance and understanding the students are looking for as they make critical career choices. F1iS is considered by the students as “Cool” and it uses this status to attract the intrinsic interest of students. Once the door of intrinsic interest is open it uses motivators which the students can relate to, to change the career choice norms of the students.

The story about Engineering needs to be told in a different way to Boys as compared to Girls. Boys need continuous human interaction particularly with role models and mentors to perform at their peak. Boys learn by apprenticeship and respond to the influence of role models. They need to touch jobs prior to making an emotional decision about career engagement. Movement of Boys into Engineering careers will be increased by facilitating interaction between students and adults in Engineering roles. Part of this message is that during their career journey there will always be engineers around them who will help them to learn and grow. Engineering should be sold to Boys as a continual learning process.

The selling pitch to attach Boys to Engineering could be the following:

- *Engineering will allow you to design many really cool things ... and throughout your career you will have the opportunity to work in great teams and learn continuously from the very experienced engineers you will work with... your career will be one of continuous discovery.*

Girls respond to managing complexity in environments. Highlighting the processes and complexity involved in Engineering will attract them to the profession. Girls will respond to the project management aspects of Engineering careers and need to understand the processes involved in Engineering projects. The selling pitch to attach Girls to Engineering could be the following:

- *Engineering is a profession which requires a great deal of management to bring together all the different skills and processes needed to achieve an outcome ... throughout your career you will be required to manage and coordinate complex sets of tasks to bring a project to a successful conclusion.*

It is possible for Industry to effectively sell the value of Engineering as a career path to students. It is also possible to sell the Engineering profession as an important part of our Australian society to the community at large. The story behind how the Snowy Mountains Scheme (SMS) became part if the psyche of the Australia public is an example of how the broad community can develop an emotional buy-in for Engineering and Engineering projects.

> ### SNOWY MOUNTAINS SCHEME
>
> *The Snowy Mountains Scheme has achieved a status of "cool" in Australian society. Australians have an emotional attachment to the Snowy Mountains Scheme (SMS), the people who worked on the project and the role the project played in the development of our nation. It was this emotional attachment, which drove the community's rebellion against the public sale of the Snowy Mountains Authority in 2006.*
>
> *What facilitated the SMS becoming so embedded in the Australian psyche was the way it had been sold to the community, over time, in a manner which fitted with the different motivational drivers of both Men and Women. i.e. the processes involved in design and Engineering of the project were clear explanation, how people came together from across the world to work together in teams, and how the project mentored and developed the skills in the people who participated. These messages trigger the same motivational response which we have found to exist in Boys and Girls.*
>
> *While Australians understand that the output of the SMS is electricity, their attachment to the project has nothing to do with the amount of electricity being generated but rather acceptance and emotional ownership of the project because they understand, from different male and female perspectives the way this Engineering project fits within their lives and their involvement in society.*

Industry needs to create a similar emotional buy-in by students toward Engineering careers and if it is to use career intervention activities as a motivational tool and it must consider the following as key points which have been shown by this research to have an influence in focusing career decisions:

- Interventions should be focused on building on the existing intrinsic interest students have in careers such as Engineering,
- Intervention activities must be "Cool" and the level of "Coolness" must be as defined by the students and not by the adults who look to create the intervention activities.
- The selling messages used to attract students to participate should match the different motivations of Boys and Girls as highlighted above,
- It is highly recommended that interventions should be based around the 10 fundamentals of Action (Experiential) Learning,

    1. Structured around sets of 6 people
    2. Action on real tasks or problems at work
    3. Learning is from reflection on actions taken
    4. Tasks within problems are individual rather than collective
    5. Tasks/problems are chosen independently by individuals
    6. Questioning is the main way to help participants proceed with their tasks/problems
    7. Activities are part of an existing program
    8. Facilitators are used
    9. Taught elements are included
    10. Linked to a qualification

- When engaging students, those engagements need to take students on a journey to the core of the complexity of Engineering and NOT focus on giving a guided tour around the final outcome of the Engineering effort,
- Interventions should be such that they are directly relevant to Engineering careers and this relevance should be in the eyes of the students,

- Industry should NOT underestimate the level of knowledge students are seeking to help make their career decisions and thus careers information supplied to students must respect their highly evolved capacity to absorb knowledge,
- Industry should become directly involved in the formation of sustainable partnerships between industries and schools in a way which increases the interaction between industry role models and the students.

There is much that industry has to do to encourage students to take up careers in Engineering. Given the high levels of intrinsic motivation being displayed by these students, the strong linkage in the literature between intrinsic motivation, self-efficacy and innovation, it is reasonable to assume that this next generation of students will be highly innovative. This is a great position for industry, and our nation, moving forward in a competitive world. All that is left is for industry to take the appropriate actions to attract these students to the profession and to the jobs that build a nation.

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