THE INTRODUCTION OF NEW ENGINEERING PROGRAMS. A CURSE OR A NECESSITY?

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Abstract

The traditional engineering disciplines seemed to have been around for a very long time, and divide our realm in the same manner that physicians and surgeons divide medicine. These classical regimes of distinctly different disciplines are so ingrained in our modern history, that few would be surprised if the latest Dan Brown novel (author of the DaVinci code) suggested that Noah had employed mechanical, electrical, civil and chemical engineers to build the Ark. The use of electrical engineers would perhaps convince the reader that the novel were fictional, unless fluorescent lighting was in fact part of the Ark's original equipment, or an after market addition. Lately however the disciplines seem to be going through a transformation that could risk loosing this well established identity, in order to ensure that engineering vocations that require more specialised courses are served accordingly.

Advances in technology demand that more and more (previously) niche areas, require more and more theoretical and technical engineering knowledge. In the last decade we have seen the introduction of Petrochemical degrees, Mechatronics Degrees, Environmental Degrees, Aerospace Degrees and Automotive Degrees. These programs have obviously been introduced to address a need, but at what expense to the more classical programs such as mechanical, electrical, civil and chemical?

This paper will focus on one particular case study; the introduction of a new Automotive Engineering Degree at the University of Adelaide, discuss the reasons for its introduction, its popularity, its success and will leave an open question: what of the classical mechanical engineering degree?

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Introduction and Background

The School of Mechanical Engineering at the University of Adelaide has always fostered close working relationships with local industry, the largest of which is the automotive sector. Australia's automotive exports rank ahead of beef, wheat and wool, and are just behind gold and iron ore in terms of their dollar value. Joint State and Federal government press releases reported that in 1999, Australian automotive exports amounted to $3.8 billion, a 36% increase on the previous year [1]. This rose to $4.2 billion in 2000 [2] and $4.9 billion in 2001 [3]. However the industry now faces a crisis, with many manufacturers and suppliers pushing their production off-shore. The remaining industry must therefore become leaner and smarter in order to survive and keep the design, manufacture and assembly of the more complex car parts on-shore [4]. The ultimate survival of the industry is essential to the Australian economy, not just because of the direct effect on export figures, but because of its influence on all of the other engineering industries. What is written on the wall for the automotive sector will ultimately apply to all. The ultimate solution to this problem rests with federal government and our industry leaders, but the requirement for a smarter professional workforce rests with the higher educational institutions. Better and more immediately proficient trades people are required from our TAFEs and more agile, adaptable engineering professionals with more directly relevant attributes are required from our universities.

Consultations with automotive sector senior managers revealed that graduating students with career aspirations in the automotive sector lack the specialised engineering, design, manufacturing and management knowledge that they expect of their new employees. They do not expect universities to provide training in company specific practices, but do believe that graduates should have developed a more directly appropriate theoretical and practical understanding of the design and manufacturing problems that they are likely to be faced with.

The curriculum of existing mechanical engineering programs are not wrong, they are simply too ambitious in attempting to embed their graduates with all of the necessary knowledge and attributes for an exponentially expanding discipline in terms of the technology and theory that they all envelop. Consequently most of Australia's universities now recognise this and offer specialised programs that are fundamentally "spin-offs" from more classical degrees [5]. One example: Mechatronics, the hybrid of mechanical engineering, electrical engineering and software engineering is now widely becoming recognised as a main stream degree. Our need to understand the damage that we inflict upon our planet demands a far better understanding of the environment and so many Schools of Civil Engineering offer Environmental Engineering degrees.

Vocational degrees such as Aerospace, Aeronautical and Automotive Engineering are also now far more common because each industry focuses on specific niche areas of engineering, for which our graduates require prior knowledge; so that they can quickly develop their area of specialisation once they enter into professional practice.

The push however is far from one sided. It is not only the employers (the consumers of our products – our students) that require engineering specialisation; it is our customers (also our students) as well [6].

Figure 1 shows the results of a 2003 survey that was conducted on one hundred and fifteen first year mechanical engineering students, to establish their views regarding a possible automotive engineering program. Fifty six percent of the students chose a mechanical engineering degree because of what they knew the automotive sector sparked their interest in mechanical engineering. The same percentage actively sought a career in automotive engineering and chose mechanical engineering in the absence of an automotive degree. At the

time, there was evidence that South Australian students had moved interstate to enrol in Australia's only automotive program at RMIT in Victoria, rather than enrol in the more generic mechanical engineering program.

Fifty four percent would consider transferring to an automotive degree if it were available, but only 40% would have preferred an "automotive" degree. This latter statistic, which somewhat contradicts the initial two, reveals a perceived issue about "branding", since eighty four percent of the student surveyed stated they would prefer a Mechanical Engineering Degree with an "Automotive Major", rather than an Automotive Engineering Degree. They want the content, but under a different heading. These all however do clearly demonstrate that a significant number of students enter into mechanical engineering programs towards a career in the automotive sector, but while many want to specialise and are attracted by specific automotive engineering areas, they still want to retain the perceived flexibility associated with a more main stream degree.

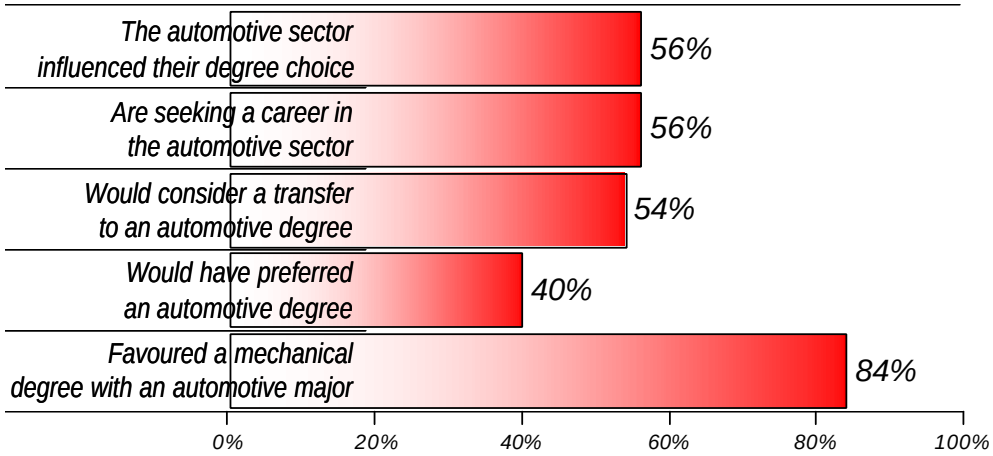

Figure 1: The results of a 2003 mechanical engineering student survey

The Introduction of an Automotive Engineering Program

The University was not able to financially support the required additional resources for specialised automotive degree and so the required funding was raised via the development of an automotive industry consortium, which provided financial, in-kind support and a continuous close working relationship. Consequently, the University was able to introduce the first, second and third year of a new four year Automotive Engineering Degree in 2005.

The first and second year of the automotive engineering program retains all of the mechanical engineering courses, so that a firm foundation in mechanical engineering remains. However, courses that were considered less necessary to an automotive engineering career have been removed from the third year and replaced with more aptly specialised courses. The fourth year of the mechanical program is a significant research and design project, with the remainder of the program made up from electives (courses selected form a list of those available). In the automotive program a similar project must have an automotive focus and the choice of electives is removed so that students must study relevant and specialised automotive courses, some of which are electives for mechanical engineering students.

However, despite the feedback of enrolled students favouring a Mechanical Engineering Degree with an automotive major, an Automotive Engineering Degree was chosen as the program title. From the University (rather than student) perspective, this has a distinct marketing advantage in that the program is far more obvious in the SATAC (South Australian Tertiary Admission Centre) guide, which is the primary document that school leavers read in order to decide upon which tertiary education program to study. High school students not yet enrolled in an engineering program, nor familiar with the structure of an engineering degree program, would be attracted by the far more direct title. Regardless of the branding issue (and whether or not the correct title was chosen), as the next section will show, the introduction of the degree has proven to be a huge success.

Results and their significance

Australian universities cannot usually measure success by the number of students that they attract because places are strictly limited and are always readily filled. South Australian universities (as do Tasmanian, Western Australian and the Northern Territory Universities) therefore usually refer to a Tertiary Education Ranking (TER) cut-off score to measure a program's popularity. Queensland has a more complex system, but in Victoria the term used is an "Equivalent National Tertiary Entrance Rank (ENTER)" and in NSW it is called a "University Admissions Index (UAI)". All are percentile rankings of completing high school students, and so in all cases reflect the academic performance of completing high school students compared to their peers. In a nutshell, students fill up program places in rank order of their overall academic standing. The last one in (with the lowest rank) is the cut-off score.

In its inaugural year the TER cut-off score for Automotive Engineering was 95.5 which meant that all of the students that were accepted achieved a high school result better than 95.5% of all graduating high school students. The University of Adelaide's new Automotive Engineering Degree is a resounding success in terms of industry support (from Mitsubishi, the Department of Trade and Industry, Schefenacker, BSTG, Tenneco, Coopers Standard, Air International and Ion Automotive) and student patronisation, as was the introduction of an Aerospace Engineering Degree the year before.

A program's popularity can also be measured by the number of student applications that have it listed as a student's first preference. Figure 2 clearly shows that the mechanical engineering programs (aerospace, automotive, mechanical and mechatronic) are the most popular (in terms of first preference applications) in the faculty and that their popularity has continued to grow for the last three years.

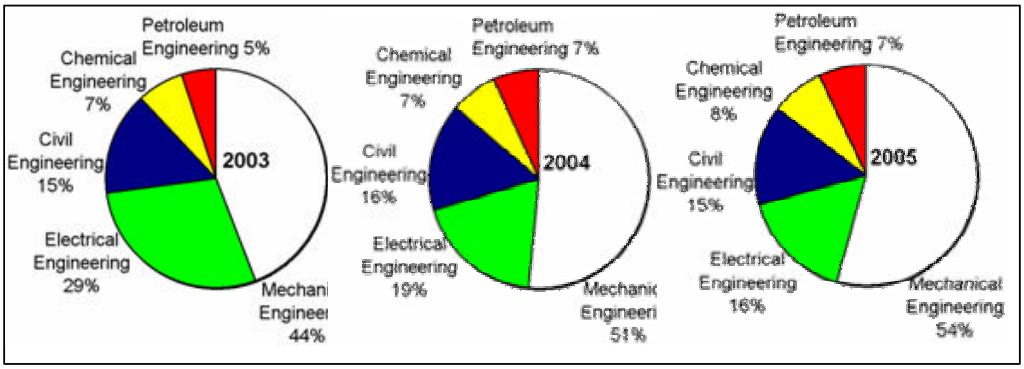

Figure 2: First preferences by School

This is despite the annually published, consistently higher TER cut-off score that its programs attain, which one may otherwise presume would risk reducing a program's attractiveness to those students less confident in their academic abilities. In the last two years, the School has attracted over half of the faculty's applicants.

From within the School of Mechanical Engineering it can be seen in Figure 3 that students' first preferences in the classical mechanical engineering program have continued to rise steadily over the years.

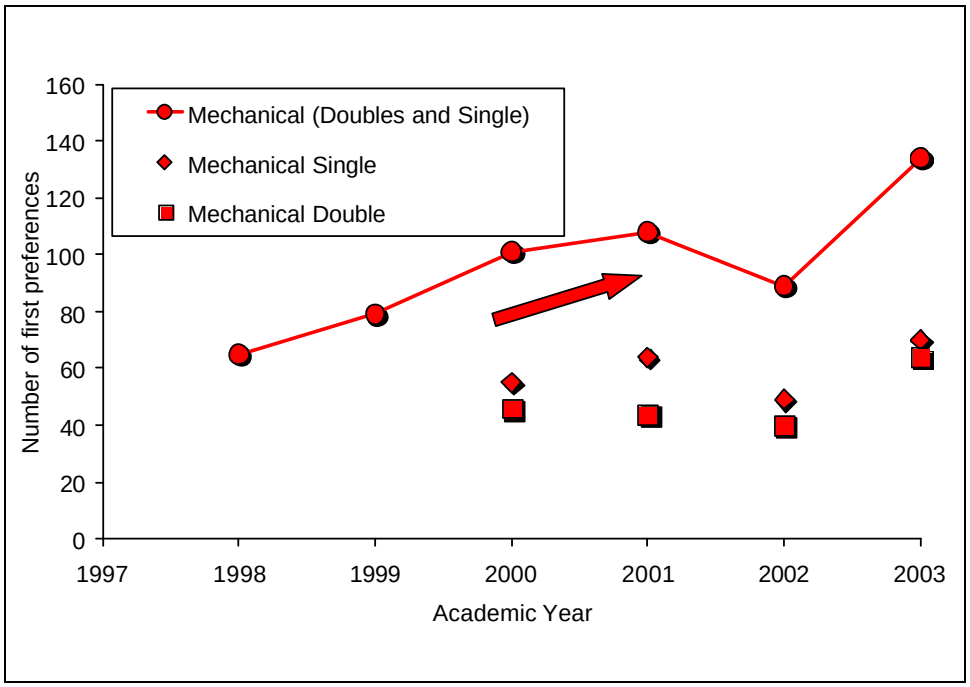

Figure 3: Mechanical Engineering first preferences 1998 to 2003

However, Figure 4 shows that when the Aerospace Engineering Degree was introduced in 2004 and the Automotive Engineering Degree in 2005, the popularity of the Mechanical Engineering Degree took a sharp down turn.

This trend does not reflect space limitations (since these are student applications, not enrolments), but it reflects the findings of the previously discussed survey in which students who were previously attracted to a Mechanical Engineering Degree with a specific vocation in mind (ie. aerospace or automotive). The provision of the vocationally focused degree provides a more direct route for students who have already decided upon a preference into their chosen area of either aerospace engineering or automotive engineering. The students who chose mechanical engineering are therefore most probably students who are as yet undecided about a specific career, or are students that want to keep more options open and maintain broader horizons in the mechanical engineering industries.

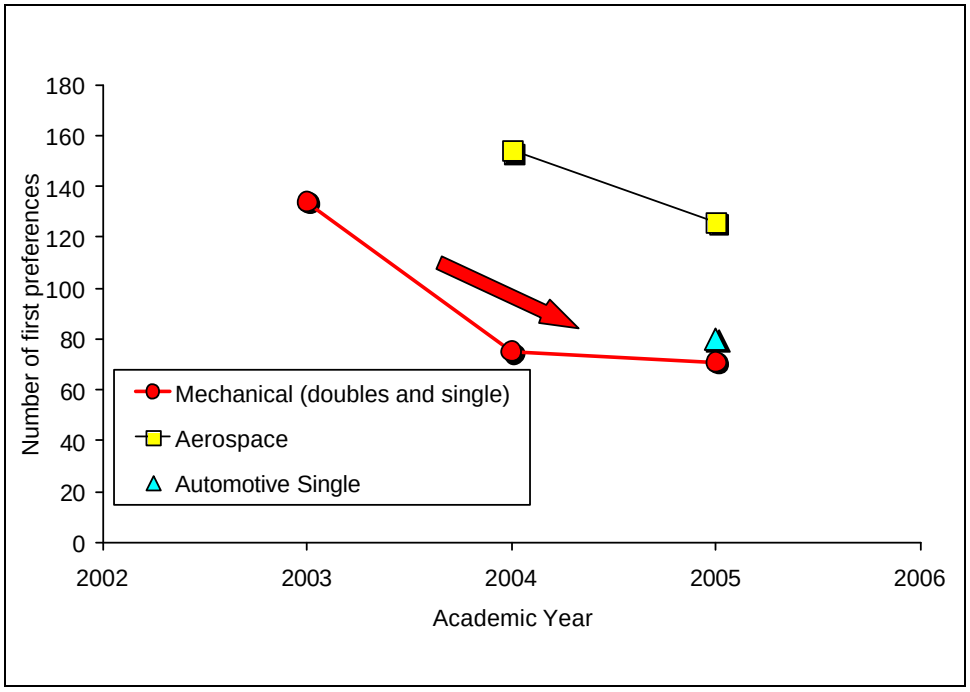

Figure 4: Mechanical, Aerospace and Automotive Engineering first preferences from 2003 to 2005

Figure 5 demonstrates the popularity of the vocationally based degrees among full fee paying applicants (who are primarily international) and demonstrates that the emerging pattern is not simply local to South Australia. It can be seen that the vocationally focused degrees are far more popular, with over 69% of the full fee paying applicants favouring them instead of the mechanical or mechatronic degrees.

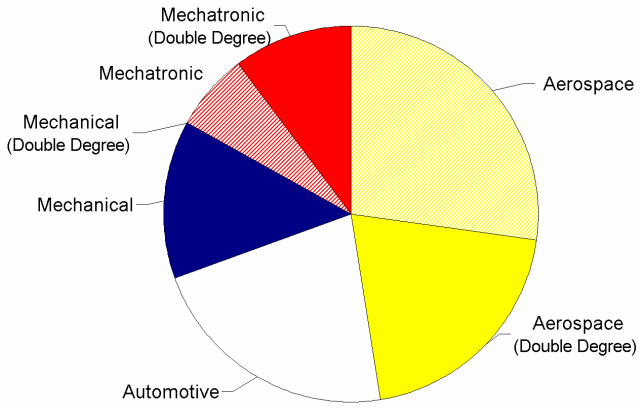

Figure 5: Distribution of full fee paying applications for 2005

Figure 6 presents another interesting finding. In the previously discussed survey, students expressed concern regarding an "Automotive Degree" rather than a "Mechanical Degree with and Automotive Major". Subsequent discussions with students revealed two reasons for this: The first was because of perceived limited opportunities associated with such a distinctive brand and the second was due to a fear that employers may interpret it as a TAFE rather than a university degree. However Figure 6 shows that students choosing an automotive degree in preference to a mechanical engineering degree have a higher TER score and are therefore probably more academically capable. A possible explanation for this may be that high academic achievers are usually extremely focused, have well laid plans and that a vocationally based program (such as automotive or aerospace engineering) provides a clearer more logical route towards their predetermined goals.

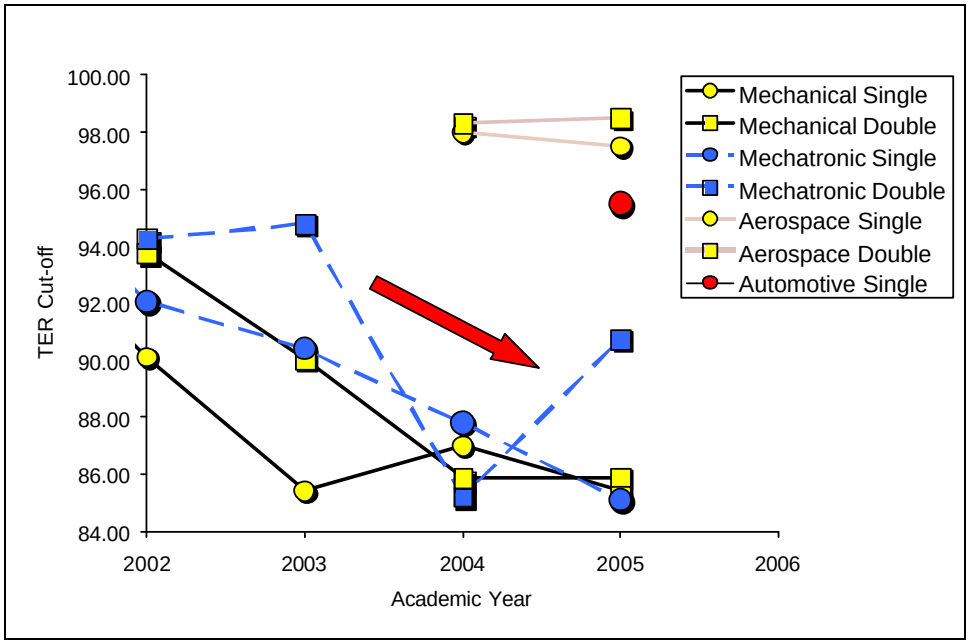

Figure 6: TER cut-off scores

Conclusions

The introduction of a new Automotive Engineering program in the School of Mechanical Engineering at the University of Adelaide has without a doubt proven to be successful among students and has received tremendous support from both industry and the state government. The industry will benefit from graduating students having a clearer understanding of the theory and practices that directly relate to their sector. Also, students entering university with a predetermined idea about their career will have a clearer pathway towards their goals. Because a vocation in the automotive sector is the premeditated choice for these students, employers will not only be able to choose from smarter (as the TER scores indicate) graduates with more appropriate attributes, but they also stand to inherit an extremely enthusiastic and determined new workforce.

While the introduction of degrees such as automotive engineering reduces the number of students who are interested in the mainstream Mechanical Engineering Degree, the future of the classic degrees remain safe and secure. While the new degrees offer genuine specialisation (not just an added hint of flavour), they are heavily built upon mechanical engineering foundations, where only the courses that are found to be less necessary to the vocational focus are replaced by more specialised and pertinent ones. This has to be the case or else engineers in these disciplines would not share the attributes of mechanical engineers. It is not intended to set automotive (or aerospace) engineers as a breed apart from mechanical engineers, but to develop mechanical engineers with automotive (or aerospace) expertise. The very existence of these new specialised degrees therefore depends upon the continued existence of the old. However, the evolution of technology and engineering theory presents students with a need to understand far more than they would have if they were graduating a decade or two ago. Niche areas of engineering are delving deep into areas that have never been considered before and it is therefore becoming increasingly impossible for a single classical degree to prepare the graduate for everything. Attempting to do so would have to dilute the educational content or extend the duration (an expense) of a degree so that it is no longer attractive to school leavers. Specialised programs are therefore both inevitable and essential. In effect though, the new highly specialised programs are, as students wished for, mechanical engineering degrees with a vocationally focused major. Universities must however brand them to maximise marketing opportunities and it is suspected that this very issue may become a subject of future debate.

The introduction of specialised degrees with distinctly different brands will ultimately cause a problem. If too many degrees emerge with a too distinct identity from that from which they evolved (while still heavily relying upon them), the perceived value of engineering may become undermined. It may well become too hard to see the wood from the trees. Also, will the good ol' mechanical engineer be perceived as a Jack of all trades?

BIBLIOGRAPHY

1. *Vaile, M and Minchin, N (2000). Automotive Exports Reach New Record: Joint Media Statement from the Australian Minister for Trade and the minister for Industry, Science and Resources. Tuesday, August 15, 2000.*
2. *Vaile, M. (2001). Auto Exports Reach New High: Media Statement from the Australian Minister for Trade. Monday 26 February 2001.*
3. *Vaile, M. (2002). Cars Drive Into the Top Ranks of Australia's Exports: Media Statement from the Australian Minister for Trade. Tuesday 11 June 2002.*
4. *Porter, I. (2005). Parts offshore but car makers stay. The Age, March 2nd 2005. www.theage.com.au/news/Business/ Parts-offshore-but-car-makers-stay/2005/03/01/1109546867100.html*
5. *The IEAust list of* Accredited Professional Engineering Programs *(2005). http://www.ieaust.org.au/membership/res/downloads/AccredBEprogs.pdf*
6. *Snyder, S.D. (2002) "Vertically integrated projects and the importance of the organisational culture in the student body" IJEE, Vol18, No.3 pp. 307-314.*