Application Rates to Undergraduate Programs in Information Technology in Australian Universities

John F. Roddick[1] **Adrienne L. Nieuwenhuis**[2]

[1] School of Informatics and Engineering
Flinders University of South Australia,
PO Box 2100, Adelaide, South Australia 5001,
Email: roddick@cs.flinders.edu.au

[2] Registry
University of South Australia,
City East Campus, Adelaide, South Australia 5000,
Email: adrienne.nieuwenhuis@unisa.edu.au

Abstract

Over the past decade, there has been much discussion regarding both the supply and the current and potential demand for information technology-oriented graduates in Australia with numerous surveys and market analyses being undertaken. Some surveys have focussed on the supply of graduates from the tertiary and VET sectors and their demand in Australian industry, while others discuss enrolment statistics into IT based University and VET sector courses. Few, however, investigate application rates to IT courses.

At the same time, there has been a general, and in some cases significant, decline in the application rates for some science and engineering courses prompting universities to review their awards with a view to making them more attractive to students and industry. In many cases this has resulted in the development of more highly specialised awards and in others in substantial shifts in quota.

In this paper we investigate application trends for information technology-oriented awards from a number of perspectives, including the market perceptions of the institution offering the degree and the manner in which the award is combined with other disciplines. Although this study takes advantage of the centralised admissions systems used in Australia, data available elsewhere shows that the results may be applicable more broadly.

Keywords: University Undergraduate Application Rates, Information Technology, Computer Science, Management Information Systems, Software Engineering, Computer Systems Engineering.

1 Introduction

Over the past year, three new reports have been issued [8, 9, 17] which discuss the supply and demand for IT qualified staff in Australia[1]. This follows a number of previous market analyses almost all of which have concluded, notwithstanding recent market declines, that there is a significant shortfall in supply. Moreover, the SACES report [17] concludes that by 2005 there will be a net loss in skilled migration from Australia in the area of IT qualified staff. In an attempt to solve this problem, the Federal Government has recently announced 2,000 additional places in IT, Science and Mathematics.

[1]For the purposes of this paper, the terms ICT (Information and Communication Technologies), IT (Information Technology) and IT&T (Information Technology and Telecommunications) are considered interchangeable. This is in line with the definition used by the Australian Computer Society.

Despite this research, few analyses have been undertaken that investigate the supply of applicants for University places (although the SACES report discusses unmet demand in terms of applicants that failed to gain places at University).

In this paper we investigate application trends (as opposed to the more commonly studied enrolment trends (cf. [2])) taking advantage of the availability of data through the centralized admissions systems existing in Australia. We believe that this reflects the popularity of disciplines more accurately than that of enrolment data. For the purposes of this paper, we define demand as the level of first preferences (at the close of business for the year) for an award as recorded by a tertiary admissions centre or equivalent. It should be noted that some applications come from those already enrolled in an IT degree, either attempting to transfer to a different award or a different institution. Thus absolute demand is overstated although the trend data is likely to be accurate. Countering this to some extent is direct entry that results in intake that is not represented in the tertiary admission centre statistics.

Although focussing on different aspects, in some respects this paper can be considered a companion paper to [18] which investigated more broadly the application rates to Science, Technology and Engineering. In [18], data for information technology was treated as one category and compared with four categories – Mathematical, Chemical and Physical Sciences, Biological and Environmental Sciences, Construction Engineering and Resource Engineering. Although some results are repeated in this paper where appropriate, readers are directed to [18] for a more comprehensive discussion of the general science and engineering issues.

2 Background

Over the past decade, many Australian Universities have shifted some of their emphasis from broad-based generic undergraduate science degrees towards named specialist or vocationally-oriented degrees. This has included courses in information technology and has been the result of a number of factors, including industry demand, student preference and an increasingly competitive domestic and international market.

At the same time, overall demand for science and engineering awards as a whole has fallen (between 1995 and 1999 preferences for the science and engineering awards fell by 6%). Within that figure however applications to IT courses rose 18% while Resource-based Engineering fell 23% (see Figure 1). The uneven pattern of that decline, coupled in some

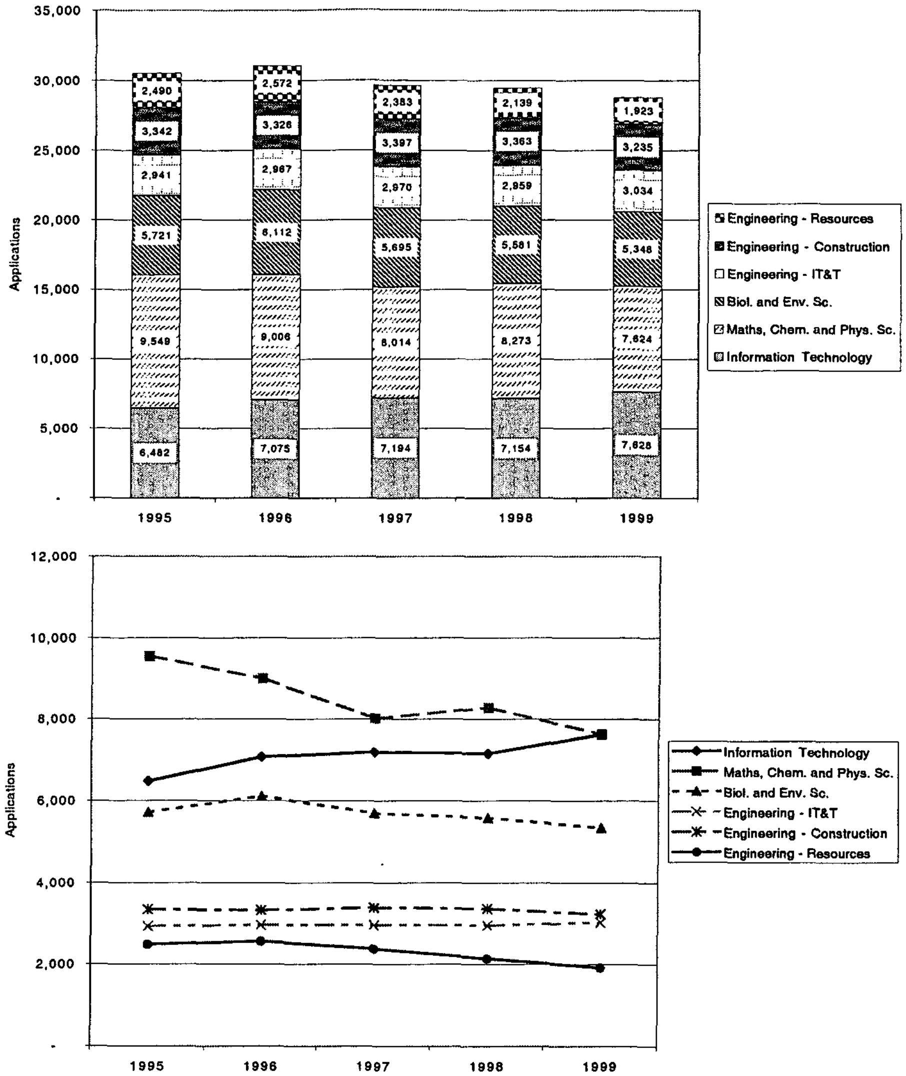


Figure 1: Application Rate for Science, Technology and Engineering Awards, 1996-1999

cases with high attrition rates, has prompted many institutions to review, in some cases radically, which awards to offer and, in same cases which awards or even disciplines to retain. These trends have been mirrored in the U.K. where, between 1996 and 1999, there was a 39% increase in applications for awards in information technology and a fall of 8% in science and 17% in resource-based engineering oriented courses [20]. While this paper does not cover attrition rates, it is important to note that both in the U.S. (see [19] for a discussion) and in Australia (see [2]) the attrition rates in science and engineering are higher than in other disciplines and have added to the problems of weak demand in those areas.

This paper is structured as follows. In the next section the authors review previous studies in this area including the availability of government statistics. Section 4 then discusses the methodology and scope of the study while the results and inferences of the study are discussed in Section 5. Section 6 then gives some brief conclusions.

3 Previous Studies

A number of studies over the past decade have concluded that the U.S., U.K., and Australian education systems are producing far fewer scientists and technologists than will be needed to maintain a technologically advanced economy [1, 2, 4, 5, 6, 10, 11, 12, 14, 15, 16]. For example, in 1998, the Australian Council of Deans of Science (ACDS) commissioned a study on enrolments in response to public concerns about an apparent decline in the number of students undertaking university science awards. This ACDS study revealed two important issues. First, that the DETYA defined broad fields of study code are generally too broad to base strategic decisions, with variation in enrolment patterns within the science-based disciplines being masked by the wide variations within the categories. Second, when subdivided using other available data, an increase in enrolments in computer science awards of close to 80% between 1989 and 1997 becomes apparent, together with significant declines in the study of mathematics and the physical sciences.

3.1 Double Degrees

However, while many IT based courses do not have formal prerequisites, the ability of students to succeed in such courses is linked to subject choice and preparation at secondary school. Many students in Australia, for example, leave school without undertaking or passing the necessary prerequisite or assumed knowledge topics for entry to IT awards at university [7] and, as reported in the ACDS study [2], of the students who do undertake a combination of subjects best suited for study in science and engineering awards at university, only about one-third of students (based on Victorian Certificate of Education data) actually progress to these awards. This is reflected in the 1998 NSF report [13] which states that

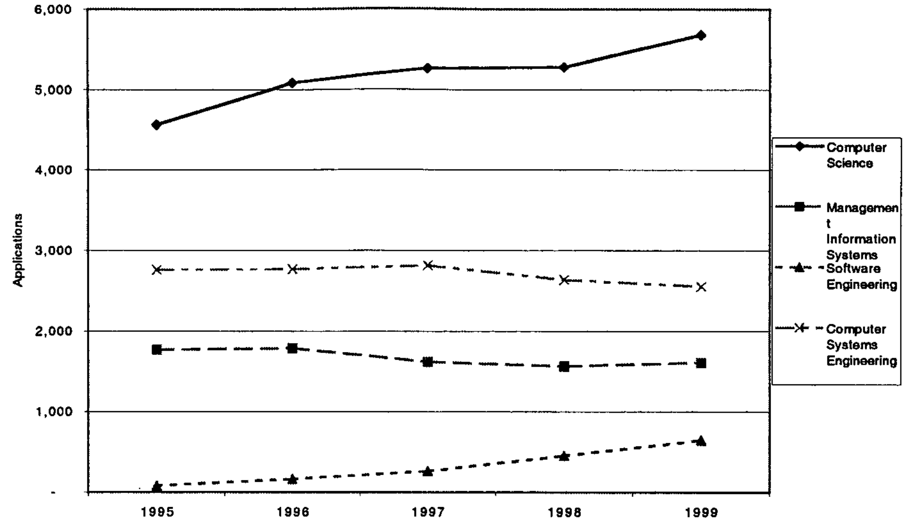


Figure 2: Application Numbers, 1995-1999

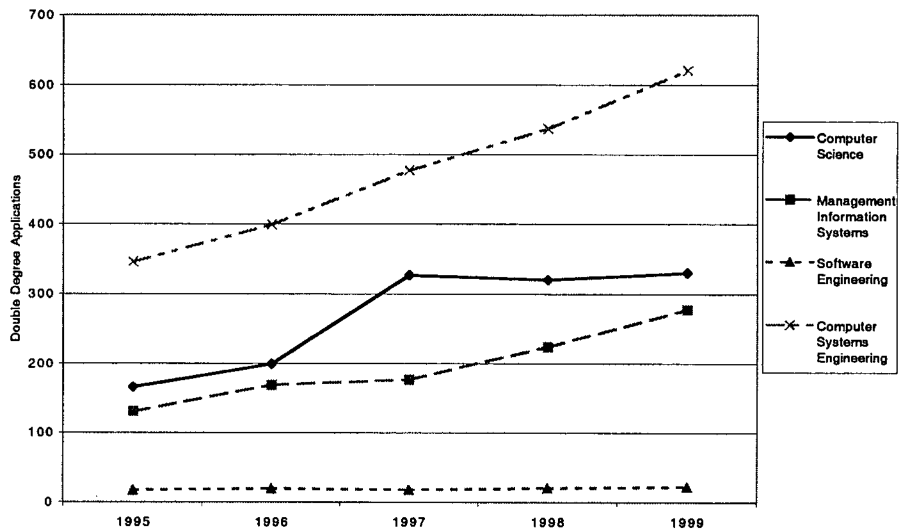


Figure 3: Growth in Double Degrees, 1995-1999

[m]easured educational progress of 8th and 12th grade students indicates a decline over the high school years in the fraction that can perform at least at basic levels of proficiency in mathematics and science.

Although application data is a key determinant in strategic planning by government and award planning by Universities, by and large, prior, publicly available research in this area has concentrated on enrolment rather than application trends (q.v. [3]). While enrolment data is useful, particularly as a predictor for eventual graduate numbers, application data provides a more accurate measure of the *popularity* of an award as it is a more direct reflection of student demand. It is, for example, largely independent of *ad hoc* quota shifts within universities' profiles. It is, therefore, important that a quantitative analysis of the popularity of awards based on application data is carried out to determine the magnitude of these changes in student award choice and to predict future trends.

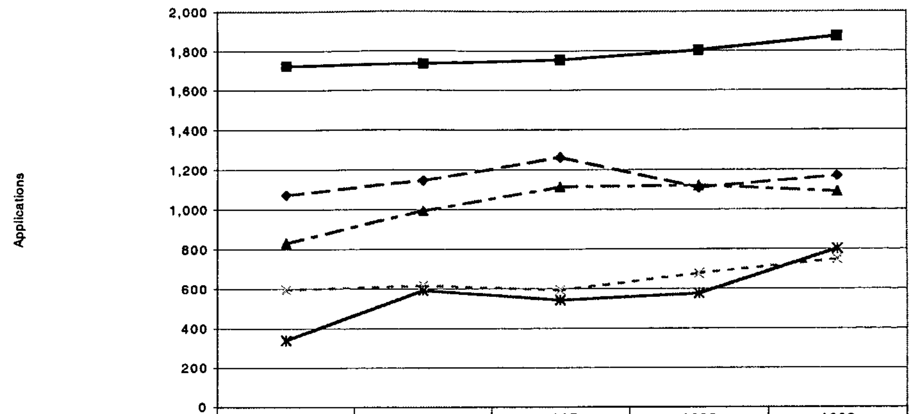
4 Methodology and Scope of the Study

The data used in the study was supplied by the tertiary admissions centres in South Australia (SATAC), New South Wales (UAC), Queensland (QTAC) and Western Australia (TISC). Data for awards in Tasmania were obtained directly from the University of Tasmania and the Australian Maritime College[2]. By agreement, in accepting the data for the study, state by state comparisons are not reported. For comparison, data was obtained from the *University and College Admissions Service* in the U.K.

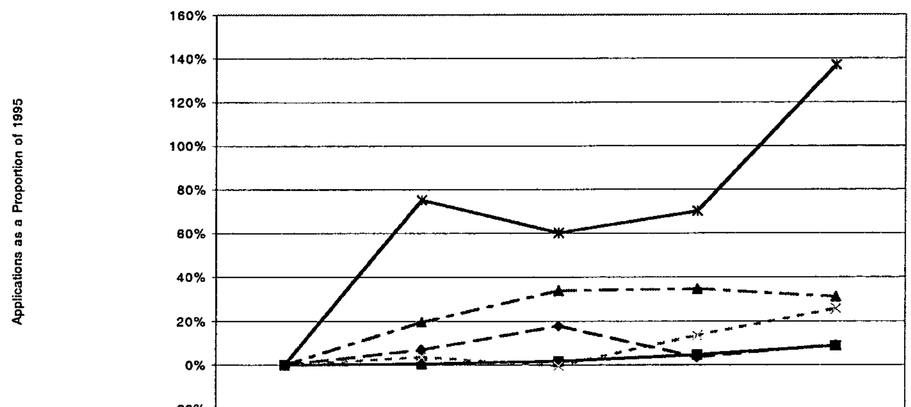
First preference data only have been considered as factors such as the number of awards available and the total number of preferences allowable differ from state to state and from year to year. In all, 378 Bachelor-level awards from 29 of Australia's 36 Universities were considered in this study representing approximately 49,000 applications (or about 10,000 applications per year) over the five years of interest.

As one point of international comparison, UCAS data [20] from the U.K. was analysed and, as far as can be judged from the data alone, generally concurs with the results available from Australia. The UCAS data lists all preferences, and the data, for the disciplines covered by this report, are listed in Ap-

[2]Data for Universities operating in Victoria could not be obtained due to an agreement between the Universities and the tertiary admissions centre in that state not to release the detailed information. However, aggregate data supplied by VTAC was seen to correlate with the rest of the data. Data for some Victorian universities' awards were available where their admissions were handled through interstate admissions centres.



	1995	1996	1997	1998	1999
Traditional	1,071	1,146	1,262	1,109	1,169
Technology Network	1,724	1,736	1,755	1,804	1,874
City-based 1960s	831	994	1,112	1,119	1,089
Regional	596	617	593	677	749
Other City-based	338	593	542	575	801



	1995	1996	1997	1998	1999
Traditional	-	7%	18%	4%	9%
Technology Network	-	1%	2%	5%	9%
City-based 1960s	-	20%	34%	35%	31%
Regional	-	4%	-1%	14%	26%
Other City-based	-	75%	60%	70%	137%

Figure 4: Applications to Computer Science awards by type of institution (a) applications, 1995-1999 and (b) change relative to 1995

pendix A.

This paper focuses on application rates rather than on admission rates, which were considered to be an indication of the supply of places. Similarly, cut-offs, are not considered as they are a product of supply and demand. It is nevertheless acknowledged that some measure of self-selection occurs when the stated tertiary entrance rank (TER) cut-offs are high and intake quotas are small. Countering this, to some extent, high TER cut-offs attract some first preference applications at the expense of similar awards with lower cut-offs.

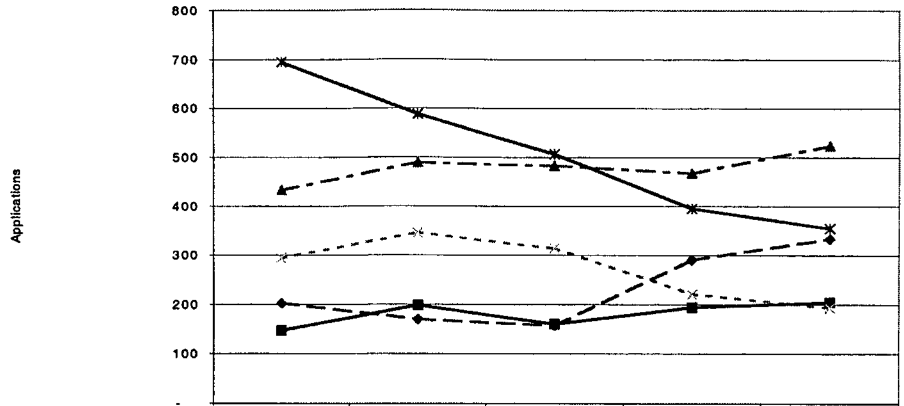
4.1 Categorisation of Awards

In order to perform the analysis, awards were grouped into one of four categories. Some awards can be considered to fall into multiple categories. For example, an award with significant studies in both avionics and computing could be considered as both a CS award and a CSE award. In order that the information presented about each discipline can be read independently, where this situation occurs, either the award is explicitly listed as being in one or the other (see below), or the award data is included in *both* categories in an appropriate proportion, which was estimated from the description of the award in the admissions guides (and thus the totals are still the sum of their parts). For double and dual degrees the application numbers were also listed under all applicable categories (again, using an appropriate proportion). Three and four year bachelor level degree awards and double degree including such awards only were investigated.

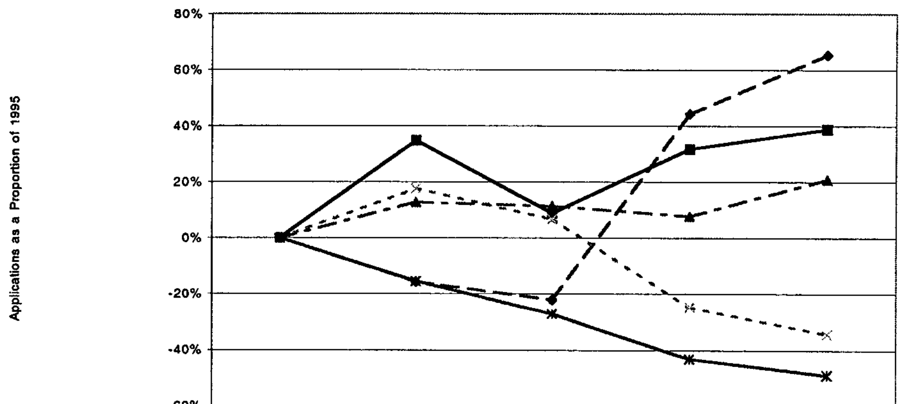
The disciplines covered by this paper are categorized as follows:

- **Computer Science**. This category also includes courses described as broad-based *Information Technology* courses.
- **(Management) Information Systems**. This category includes those listed as *Business Systems*, *Business IT* and *Business Computing*.
- **Software Engineering**, whether listed as Bachelor of Engineering or as some other award.
- **Computer Systems Engineering**. This category also includes the small number of courses listed as *Network Engineering* or *Telecommunications*, but excludes courses listed as *Electronic Engineering* or *Electronic Systems*.

Note that this study excludes some awards that might have been included such as geomatics, geoinformatics and spatial information systems. In many cases, the composition of the IT component of these awards were not clear from the descriptions.



	1995	1996	1997	1998	1999
Traditional	202	170	157	291	333
Technology Network	147	198	160	194	204
City-based 1960s	433	488	482	467	523
Regional	294	346	314	221	193
Other City-based	695	588	506	395	355



	1995	1996	1997	1998	1999
Traditional	-	-16%	-22%	44%	65%
Technology Network	-	35%	9%	32%	39%
City-based 1960s	-	13%	11%	8%	21%
Regional	-	18%	7%	-25%	-34%
Other City-based	-	-15%	-27%	-43%	-49%

Figure 5: Applications to MIS awards by type of institution (a) applications, 1995-1999 and (b) change relative to 1995

5 Results

Figure 2 shows the overall variation of applications across the above four categories. (Full data are available in Appendix B). It shows substantial growth in applications in Computer Science and Software Engineering with small falls in the other categories. Moreover, demand has shifted from traditional composite (eg *BSc(Computer Science)* awards to newer-style named awards (with titles such as *Bachelor of Computer Science (Networked Systems)* or *Bachelor of Electronic Commerce*).

The development and popularity of various combinations of double degrees are also evident. Figure 3 shows the growth in applications for double degree awards for each of the disciplines identified[3].

In total, double degree applications as a proportion of total applications have doubled from (a weighted) 5% in 1995 to 10% in 1999 although applications for double degrees involving the emerging software engineering courses have remained low. This is significant given that double degree awards represent 42% of the 378 awards considered by this paper.

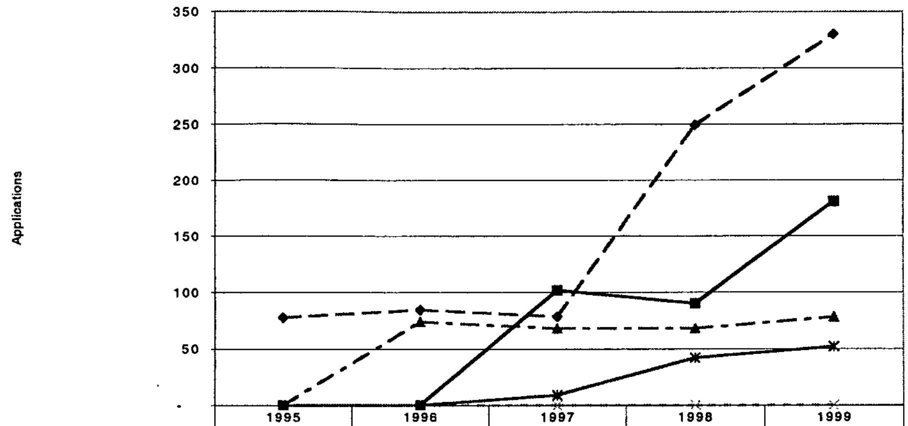
A particular point if interest has been the rise in double degrees involving computer systems engineering where double degrees now represent 24% of applications.

5.1 Perceptions of the Institution

The authors were interested in looking at the diversity of perceptions among applicants toward different types of universities in the sector. For the purposes of the study, institutions were therefore categorized into the five groups listed below.

- **Traditional**, which includes those Universities that existed prior to 1960.
- **City-Based 1960s**, which includes the capital city based Universities established in the 1960s.
- **Technology Network**, which includes those Universities which grew from the former Institutes of Technology in the late 1980s and early 1990s.
- **Regional**, those universities *primarily* serving non-capital city towns and regions. Note that regional campuses of city-based institutions are not recorded in this category.
- **Other City-Based**, post 1987 universities.

[3]For the purposes of this study, in order that each application counted equally, we have assigned a weighting to each double degree application to account for the proportion of study not in IT. For example, for a double degree, BIT with BA, a figure of 0.5 was applied to each application. For a double degree, BIT with BEng(CSE), appropriate weightings were applied to each of the sub-categories represented in the award.



	1995	1996	1997	1998	1999
Traditional	78	85	79	249	330
Technology Network	-	-	102	90	181
City-based 1960s	-	74	68	68	78
Regional	-	-	-	-	-
Other City-based	-	-	9	42	52

Figure 6: Applications to Software Engineering awards by type of institution, 1995-1999

Inevitably, some differences within these groups were apparent, although a remarkable level of correlation was found using these definitions. One of the more surprising results of the study has been the change in application patterns according to this broad categorization of institutions as shown in Figures 4 to 7.

The figures show some marked variations in demand across the sector. With respect to applications for computer science awards, for example (Figure 4), all categories have shown an increase in applications over the four years. By far the highest growth, however, has been in the Other City-Based institutions, which have attracted a 137% increase in applications. This growth mirrors to some extent the decline seen in their MIS numbers. In all, the increase to computer science application across the sector is approximately 25% over the four years, although there is anecdotal evidence and initial data from SATAC that implies that the Computer Science application rate may be close to its peak.

The Management Information Systems numbers show far more variability between institution type with the traditional universities experiencing a steady increase and the Other City-Based institutions showing a marked decline. In total, MIS has experienced a 9% fall in the years under analysis.

While most often considered within the aegis of computer science departments, software engineering has a close relationship with computer systems engineering topics and thus has been listed separately. The figures show substantial growth (albeit from a low base) particularly from traditional and technology network universities. The IT&T based engineering awards (Figure 7) show relatively flat application levels for all types of universities with minor declines experienced by some. The larger decline in applications for regional universities in IT&T based engineering and the relatively static application rate in information technology helps to explain the overall 17% decline in applications in IT, Science, and Engineering (see [18])by these institutions.

6 Conclusions and Future Research

The analysis presented in this paper has shown that despite a relatively modest gain of 3-4% per year in applications across the studied disciplines as a whole, significant changes have occurred within these categories. In particular, there has been a decline in the popularity of management information systems (of 9%) and computer systems engineering (of 8%), while there have been increases in applications in computer science and software engineering. The increase in double degree applications masks, to some extent, the magnitude of these changes. Moreover, as can be seen from the figures, the changes experienced by the different types of institutions have not been uniform and even within these categories, one institution may have a particular profile of change, which may be of significance in individual award planning.

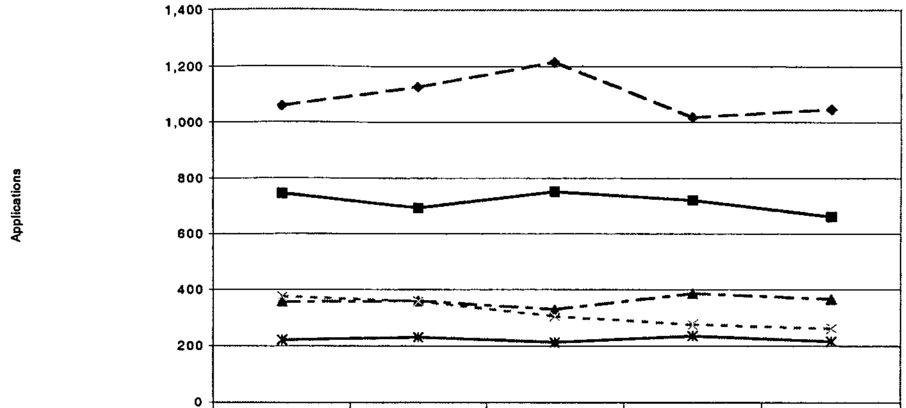
Two particular areas of concern which warrant further investigation are as follows:

- There has been a lack of growth shown in IT courses at regional institutions with this category experiencing falls or no growth in all discipline categories except computer science. This is particularly disappointing as IT holds the promise of helping rebuild regional economies.
- As reported in [8], women remain underrepresented in information technology. The report identified four barriers to participation, including the image and character of the industry, inadequate and dated careers information in schools, inappropriate teaching and learning strategies in schools and the influence of the home on career choice perpetuating stereotypes. This research did not have access to a gender breakdown of applications but from the small volume of data that is available, it is clear that these problems are also reflected in application rates.

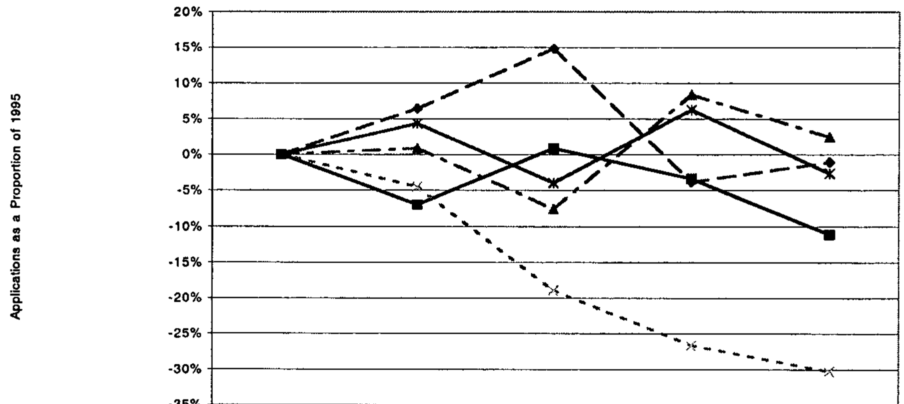
This research worked entirely from the data provided (and the constraints imposed) by tertiary admissions centres. It is clear from this work that variations in demand means that strategies to improve the supply of graduates cannot treat IT as a single discipline. Instead, finer grain delineation of the separate career paths within IT must be undertaken.

7 Acknowledgements

The authors are grateful to the tertiary admissions centres in South Australia (SATAC), New South Wales (UAC), Queensland (QTAC) and Western Australia (TISC) and to the University of Tasmania and the Australian Maritime College for making both their data and their time available to us for this study. Thanks are also due to UCAS in the U.K. for making their data available for comparison and for the useful comments received from Myles Boylan of the Division



	1995	1996	1997	1998	1999
Traditional	1,058	1,126	1,215	1,017	1,046
Technology Network	745	693	751	719	662
City-based 1960s	357	360	330	387	366
Regional	376	359	305	276	262
Other City-based	221	231	212	235	215



	1995	1996	1997	1998	1999
Traditional	-	6%	15%	-4%	-1%
Technology Network	-	-7%	1%	-3%	-11%
City-based 1960s	-	1%	-8%	8%	2%
Regional	-	-5%	-19%	-27%	-30%
Other City-based	-	4%	-4%	6%	-3%

Figure 7: Applications to Computer Systems Engineering awards by type of institution (a) applications, 1995-1999 and (b) change relative to 1995

of Undergraduate Education at the NSF in the U.S. Finally, we would also like to thank the anonymous referees for their useful comments.

8 Appendix A

Figure 8 shows the changing applications for the discipline categories defined by U.K. universities and college admissions body, UCAS. The data was obtained from their website [20].

9 Appendix B

Figure 9 shows Australian data for the changing proportion and application numbers for each of the six sub-divisions adopted in this paper by university type. The proportion given is the proportion of each category against the total applications in Information Technology Science and Engineering for that University type and for that discipline category.

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Broad Field of Study	1996	1997	1998	1999	Difference 1996-1999
Mathematics	22845	22387	22628	23063	1%
Statistics	1292	1513	1526	1285	-1%
Computer science	66940	75530	84612	100062	49%
Computer systems engineering	3382	3502	4239	5931	75%
Software engineering	9375	11651	13780	16455	76%
Artificial intelligence	853	1056	962	964	13%
Other math. & info. sc.	902	782	826	756	-16%
Math. Sc. combinations	7821	8170	8753	9152	17%
Electronic engineering	21088	20513	19589	17720	-16%

Figure 8: Applications for selected award categories in the U.K. as reported by UCAS, 1996-1999

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Field	University Type	1995 P-UT	1995 P-DC	1995 Count	1996 P-UT	1996 P-DC	1996 Count	1997 P-UT	1997 P-DC	1997 Count	1998 P-UT	1998 P-DC	1998 Count	1999 P-UT	1999 P-DC	1999 Count
Computer Science	Traditional	44%	24%	(1070)	45%	23%	(1150)	46%	24%	(1260)	41%	21%	(1110)	41%	21%	(1170)
	Technology Network	66%	38%	(1710)	66%	34%	(1730)	63%	33%	(1750)	64%	34%	(1800)	64%	33%	(1880)
	City-based 1960s	51%	18%	(830)	52%	20%	(990)	56%	21%	(1110)	55%	21%	(1120)	53%	19%	(1090)
	Regional	47%	13%	(600)	47%	12%	(620)	49%	11%	(590)	58%	13%	(680)	62%	13%	(750)
	Other City-based	27%	7%	(340)	42%	12%	(590)	43%	10%	(540)	46%	11%	(580)	56%	14%	(800)
Management Information Systems	Traditional	8%	11%	(200)	7%	10%	(170)	6%	10%	(160)	11%	19%	(290)	12%	21%	(330)
	Technology Network	6%	8%	(150)	8%	11%	(200)	6%	10%	(160)	7%	12%	(190)	7%	13%	(200)
	City-based 1960s	27%	24%	(430)	25%	27%	(490)	24%	30%	(480)	23%	30%	(470)	25%	33%	(520)
	Regional	23%	17%	(290)	26%	19%	(350)	26%	19%	(310)	19%	14%	(220)	16%	12%	(190)
	Other City-based	55%	39%	(690)	42%	33%	(590)	40%	31%	(510)	32%	25%	(390)	25%	22%	(360)
Software Engineering	Traditional	3%	100%	(80)	3%	53%	(80)	3%	30%	(80)	9%	55%	(250)	11%	51%	(330)
	Technology Network	0%	0%	(0)	0%	0%	(0)	4%	40%	(100)	3%	20%	(90)	6%	28%	(180)
	City-based 1960s	0%	0%	(0)	4%	47%	(70)	3%	26%	(70)	3%	15%	(70)	4%	12%	(80)
	Regional	0%	0%	(0)	0%	0%	(0)	0%	0%	(0)	0%	0%	(0)	0%	0%	(0)
	Other City-based	0%	0%	(0)	0%	0%	(0)	1%	3%	(10)	3%	9%	(40)	4%	8%	(50)
Computer Systems Engineering	Traditional	45%	39%	(1090)	45%	41%	(1150)	45%	44%	(1230)	39%	39%	(1030)	36%	41%	(1050)
	Technology Network	29%	27%	(740)	26%	25%	(690)	27%	27%	(750)	26%	27%	(720)	23%	26%	(660)
	City-based 1960s	22%	13%	(360)	19%	13%	(360)	17%	12%	(330)	19%	15%	(390)	18%	14%	(370)
	Regional	30%	13%	(380)	27%	13%	(360)	25%	11%	(300)	23%	10%	(280)	22%	10%	(260)
	Other City-based	18%	8%	(220)	16%	8%	(230)	17%	8%	(210)	19%	9%	(230)	15%	8%	(220)

Figure 9: Applications in each area of Information Technology, Science and Engineering - (1) as a proportion of those applications in IT received for that type of university, (P-UT), (2) as a proportion of those received for that discipline category, (P-DC), and (3) a count of applications, 1995-1999