2011

Engineering Graduates: Preparation and Progression: Institutes of Technology Honours Bachelor Degree Engineering Graduate Study, June, 2011

James Shivnan

Austin Hanley
Athlone Institute of Technology

Mike Murphy
Technological University Dublin, mike.murphy@tudublin.ie

Engineering Graduates: Preparation and Progression

Institutes of Technology
Honours Bachelor Degree
Engineering Graduate
Study

June 2011

This study of the graduates of Honours Degree Bachelors engineering programmes in the Institutes of Technology was commissioned by the following organisations;

Athlone Institute of Technology, Cork Institute of Technology, Dublin Institute of Technology, Dundalk Institute of Technology, Galway-Mayo Institute of Technology, Higher Education and Training Awards Council, Limerick Institute of Technology, Letterkenny Institute of Technology, Institute of Technology Blanchardstown, Institute of Technology Carlow, Institute of Technology Sligo, Institute of Technology Tallaght, Institute of Technology Tralee, Waterford Institute of Technology

CONTENTS

Foreword

At a time of tremendous national challenge, financial, economic and social, it is essential that higher education plays its full role in creating opportunities for students, driving economic growth, and creating a fairer society. Of particular importance is the need for the HE system to continually reflect on its performance, to engage with its stakeholders and to seek ways to enhance and improve performance.

This study is an important manifestation of how HE is meeting this goal. Through a collective endeavour, the Institutes of Technology have examined the performance of their engineering schools, measured through the views of their own graduates and external stakeholders, specifically employers.

I am particularly pleased that the discipline of engineering has been selected for this study. Irish students continue to enter engineering and associated fields in large numbers; 12% of all entrants to Higher Education in 2009 were in the broad field of engineering, manufacturing and construction, while this number increases to 20% for the Institutes of Technology.

At the other end of the pipeline, employers continue to demand engineering skills. Indeed there is evidence now of a need to quickly grow output in these areas. Recent data suggests that there are over 1,200 vacancies in pharma and biomedical sectors, and there are also evident shortages in the ICT sector. These findings further emphasise the need for improved performance in all aspects of engineering education, both in terms of the skills being acquired by students, and measures to attract more students into these essential disciplines.

I am also pleased to note how this study is already directly addressing recommendations of the recently published National Strategy for Higher Education. Through its focus on engagement with external stakeholders, and its attention to the views of recent graduates, this study captures important data to inform the future development of engineering education in the Institutes of Technology, and more generally in Irish higher education.

The results are very heartening and provide strong validation of the role of the Institutes in engineering education. This survey provides a baseline for ongoing and systematic checking with our graduates and with industry on the effectiveness of our engineering education and offers pointers to improvement. I applaud those involved and look forward to initiatives that will arise from the findings.

John Hennessy
Chairman, Higher Education Authority

1 EXECUTIVE SUMMARY

The national strategy for higher level education underlines the importance of innovation and enterprise; and well qualified engineers are central to furthering that strategy. This honours bachelor degree engineering graduate study represents an intense dialogue between engineering faculties across the Institutes of Technology to gain insight into the quality of our engineering education.

The study provides a fresh insight into how NFQ Level 8[1] honours bachelor degree engineering graduates from the Institutes are perceived by employers, how well the graduates themselves feel they are prepared to perform as engineers, and how both employers and graduates judge the strengths and weaknesses of the engineering programmes in the light of their experience.

NFQ LEVEL 8 RESEARCH STUDY

The number of NFQ Level 8 graduates from programmes in the engineering schools within the Institutes of Technology has grown significantly since 2000.

- In 2000, the Institutes graduated almost 470 students and this number rose to more than 1,300 by 2008, largely driven by the number of honours bachelor degree programmes offered which has more than tripled from 21 to 67 over that period.
- In 2009, 56% of Irish educated NFQ Level 8 graduates in the *Engineering, Manufacturing and Construction* field of study were from the Institutes, as reported by the HEA.

As a result the engineering schools in the Institutes are interested in understanding how their NFQ Level 8 graduates are progressing. To that end a study was commissioned by thirteen Institutes and the Higher Education and Training Awards Council (HETAC). The objectives of the study were to assess the preparedness of the Institutes' NFQ Level 8 graduates for their first job and to understand how the graduates were progressing in their careers.

The study included surveys and focus groups of NFQ Level 8 graduates of institute of technology engineering schools and engineering managers from the organisations that employed these graduates.

- Almost 1,500 graduates of thirteen Institutes completed a graduate survey, representing a satisfactory response rate of 19% from the almost 8,000 invited to participate.
- Almost 75 engineering managers from organisations employing NFQ Level 8 graduates completed an employer survey, representing a response rate of 16% of the more than 450 organisations invited to participate. The organisations represented in the survey hired just over 1,600 engineering graduates between 2007 and 2009 and employ an estimated 5,000 plus engineers in Ireland.

[1] Level 8 in the National Framework of Qualifications. See www.nfq.ie

- A total of 18 focus groups were held – nine for selected graduate survey respondents across a range of engineering disciplines and a further nine for engineering managers from organisations across a number of sectors that employ NFQ Level 8 graduates.

Findings - Graduate preparation

The research study found that 83% of institute of technology graduate respondents believe their education prepared them adequately for their first job and their career. Four out of five of them agreed that their programme "prepared them for a fulfilling career".

More than 4 out of 5 respondents to the employer survey found institute of technology graduates to be either well prepared or prepared in terms of their technical skills or engineering knowledge in their field. The respondents also found the graduates similarly prepared in terms of their practical engineering and problem solving skills.

Employers reported that NFQ Level 8 engineering graduates of all institutions need to be better prepared in terms of their non-technical skills, such as communication, as only 64% of respondents found graduates of the Institutes to be prepared in these non-technical skills.

Respondents indicated that only some graduates understood the activities of the organisation they joined, particularly how engineers contributed to its operation and how their work affected financial performance. Only 35% of employer respondents found graduates of the Institutes to be prepared in terms of their commercial awareness.

Findings - Graduate progression

Approximately 8 out of 10 respondents to the employer survey found that institute of technology NFQ Level 8 engineering graduates are progressing at a similar rate in their careers as other graduates.

The careers of the majority of institute of technology graduates are progressing well, with 65% of respondents agreeing that their engineering career and associated salary has progressed as they expected since graduating. Almost 8 out of 10 NFQ Level 8 graduate respondents believe that they have been given appropriate engineering responsibilities corresponding with their engineering qualifications.

Employer respondents are also happy with the progression of institute of technology graduates with more than 9 out of 10 employers noting that these graduates either meet or exceed their employers' expectations. Respondents also reported that institute of technology and university graduates perform similarly in terms of meeting their employers' expectations.

FINDINGS - KEY SKILLS

From the graduate and employer surveys, key engineering skills were determined to include those skills critical to a graduate's engineering discipline, critical thinking and analytical skills and certain non-technical skills such as oral and written communication.

Overall, graduate respondents reported that their education at the Institutes was effective in preparing them with respect to certain key skills, with 75% of respondents reporting they were either "very well" or "well" prepared in terms of critical thinking/analytical skills and 66% feeling the same in terms of discipline specific technical skills. However, only 59% and 57% of graduates felt as prepared in terms of their written and oral communication skills, respectively.

Employer respondents reported that they are most satisfied with the graduates' attainment of technical engineering skills, with 81% of respondents indicating that they were "satisfied" or "very satisfied" with graduates in this area, while the satisfaction level for written communication was significantly lower at just 50%.

OTHER FINDINGS

The research study found that graduates believe their qualification to be well recognised by their employers and their work colleagues but the graduates feel that their qualification is less well perceived by the general public.

More than 8 out of 10 institute of technology graduate respondents are very happy to recommend their programme and 9 out of 10 are happy to recommend their Institute.

The employers and graduates who participated in the research study made a number of suggestions on how engineering education at the Institutes might be enhanced and the most frequently mentioned included:

- Provide more work placement opportunities;
- Offer better career guidance and preparation for interviews;
- Teach mathematics in an applications context;
- Provide more education about what it is to be an engineer; and
- Forge closer links between Institutes and the organisations that employ their graduates.

IMPLICATIONS

The Institutes are encouraged by the positive results within this study, including the proportion of graduates that feel adequately prepared for their first job, the satisfaction levels of employers with graduates' skills and the employers' views on the progression of the institute of technology NFQ Level 8 graduates. The findings of the research study will have a number of implications for engineering education offered across the Institutes. Two of the most significant include the teaching of non-technical skills and the enhancement of links with industry.

The teaching of key non-technical skills such as oral and written communication should be enhanced and further integrated into the earlier years of the engineering programmes. This will provide graduates with the communication skills to be better prepared for their first job as an engineer and for a fulfilling career.

Enhancing links between the Institutes and industry could include the following:

- Having working engineers present to students about the engineering tools and skills used in the workplace;
- Providing additional site visits for students to see how engineering is practiced within organisations; and
- Possibly exploring work experience opportunities for academic staff.

These activities will result in closer links with industry which will lead to additional opportunities for work placement which will further benefit the education and job prospects for the students. The links will also provide the students with a better understanding of what it is to be an engineer in the modern workplace.

Finally, the Institutes are also encouraged by the ongoing level of collaboration between institutes, of which this study is a good example. There are good practices in many institutes, and the strong network that now exists among senior academics, external examiners and the members of various panels associated with engineering programmes across the higher education institutions (HEIs) supports their more widespread adoption. In conclusion, the Institutes look forward to working together to address the findings of this study and to continue to improve the quality of engineering education in Ireland.

2 INTRODUCTION

Over the past decade the number of NFQ Level 8 honours bachelor degree graduates from programmes in the engineering schools of the Institutes of Technology has grown significantly.

Dublin Institute of Technology and the twelve Institutes of Technology with engineering schools listed below[2], wished to understand how graduates of their four-year and five-year engineering programmes at honours bachelors degree level are progressing in their careers.

- Athlone Institute of Technology (AIT)
- Cork Institute of Technology (CIT)
- Dublin Institute of Technology (DIT)
- Dundalk Institute of Technology (DkIT)
- Galway-Mayo Institute of Technology (GMIT)
- Institute of Technology Blanchardstown (ITB)
- Institute of Technology Carlow (IT Carlow)
- Institute of Technology Sligo (IT Sligo)
- Institute of Technology Tallaght (ITT Dublin)
- Institute of Technology Tralee (IT Tralee)
- Letterkenny Institute of Technology (LYIT)
- Limerick Institute of Technology (LIT)
- Waterford Institute of Technology (WIT)

To that end, together with the Higher Education and Training Awards Council (HETAC[3]), the thirteen Institutes of Technology, hereafter referred to as the Institutes, commissioned a research study of institute of technology NFQ Level 8 graduates from the years 2000 to 2008.

The study was designed to assess how theses graduates and their employers viewed graduates' preparedness for their first job and to understand the challenges they were facing in the workplace. The study also examined what elements of programmes could be enhanced to better prepare the graduate to meet the needs and expectations of employers.

[2] The Dun Laoghaire Institute of Art, Design and Technology does not have an engineering school and did not participate in the study.

[3] HETAC is the qualifications awarding body for third-level education and training institutions in Ireland outside Dublin Institute of Technology and the university sector. It sets standards, accredits programmes and qualifications and provides assurance to the public that programmes are above an acceptable threshold level of quality. HETAC also periodically conducts 'Institutional Reviews' of Institutes of Technology except DIT which is reviewed by the National Qualifications Authority of Ireland (NQAI).

2.1 Numbers of NFQ Level 8 graduates

In 2000, almost 470 students graduated from NFQ Level 8 programmes in engineering schools of the Institutes participating in this study. By 2008, this number had risen to more than 1300[4] as shown in Figure 1.

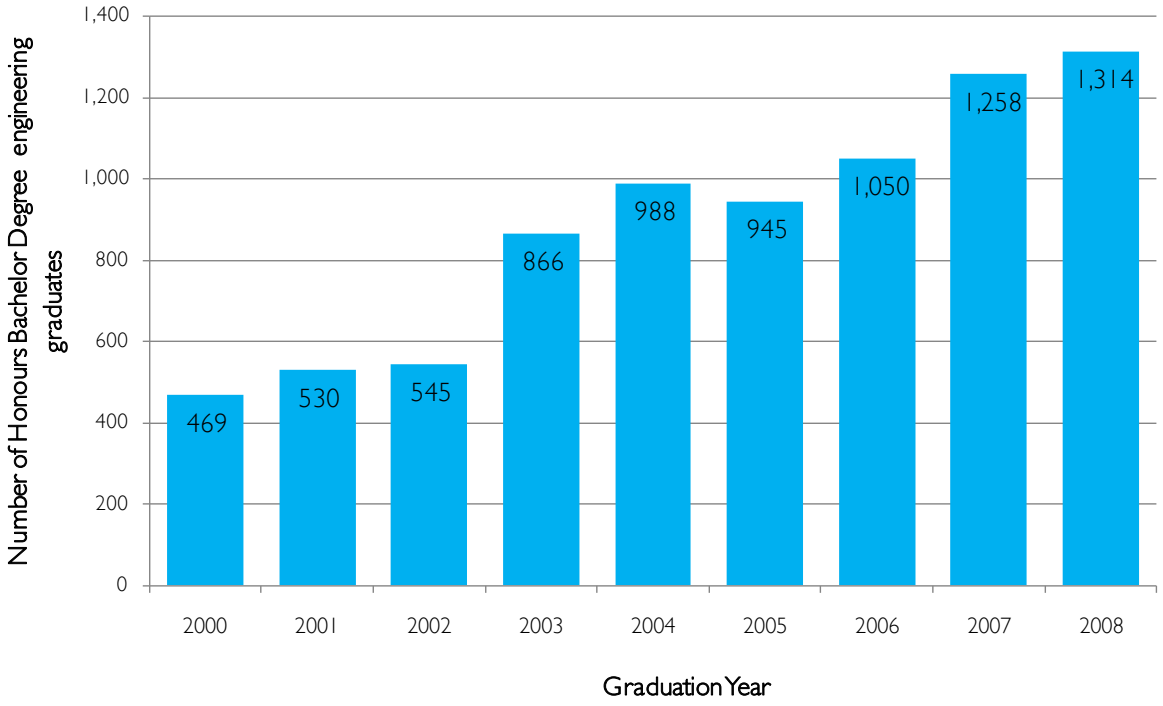


Figure 1: Institute of technology honours bachelor degree engineering graduates (2000-2008)

The increase in the number of graduates is largely due to the growth in the number and range of honours bachelor degree programmes offered. Eight Institutes of Technology have offered honours degree programmes at NFQ Level 8 since 2000 - AIT, CIT, DIT, DkIT, GMIT, IT Carlow, IT Sligo and WIT - and all Institutes have offered NFQ Level 8 programmes since 2004.

Over the period from 2000 to 2008 the number of honours bachelor degree programmes offered in the engineering schools of the Institutes has more than tripled from 21 in 2000 to 67 in 2008 as shown in Figure 2.

[4] Data is based on the number of honours bachelor degree engineering graduates that were invited to participate in the graduate survey which was provided by each institute.

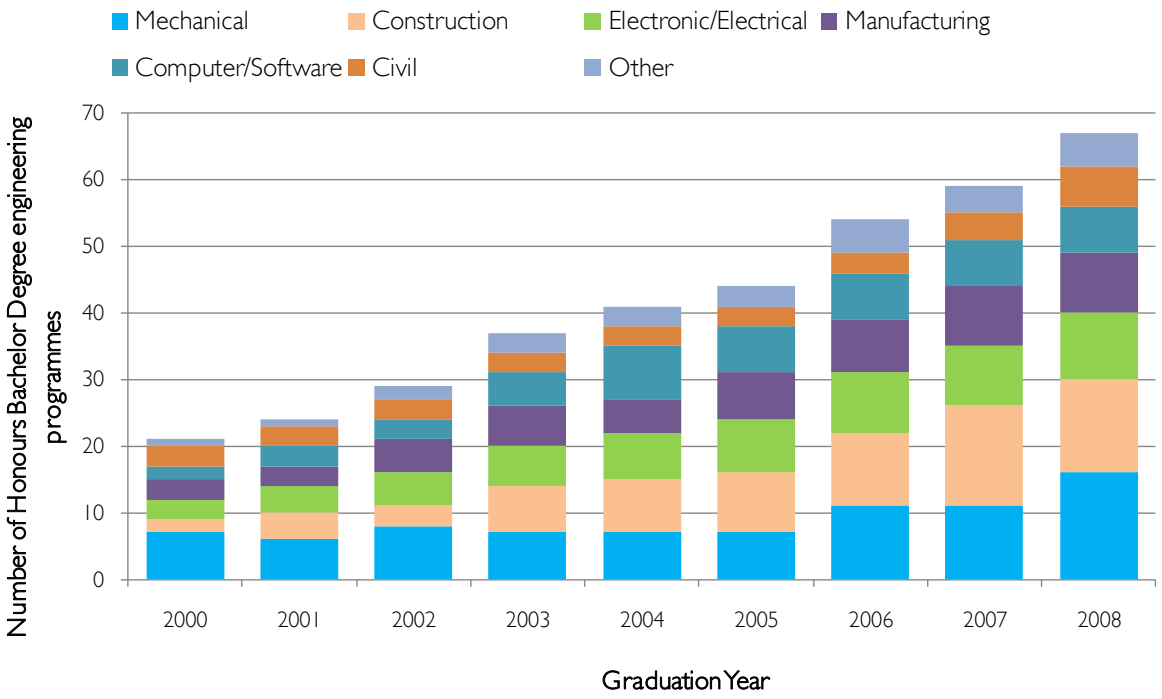


Figure 2: Number of NFQ Level 8 programmes offered in the Institute's engineering schools (2000-2008)

In 2005, the institute of technology sector accounted for 46% of the honours bachelor degree graduates in the *Engineering, Manufacturing and Construction*[5] field of study as reported by the HEA[6]. This figure rose to 56% in 2009 as shown in Figure 3.

[5] The *Engineering, Manufacturing and Construction* field of study as defined by the International Standard Classification of Education (ISCED) includes graduates of the following disciplines - Combined Engineering, Manufacturing and Construction; Combined Engineering & Engineering Trades; Mechanics and metal work; Electricity and energy; Electronics and automation; Chemical and process; Combined Manufacturing and Processing; Food processing; Materials (wood, paper, plastic, glass); Combined Architecture and building; Architecture and town planning; and Building and civil engineering.

[6] Source: Higher Education - Key Facts and Figures for the following years 05/06, 06/07, 07/08, 08/09 & 09/10. Higher Education Authority www.hea.ie.

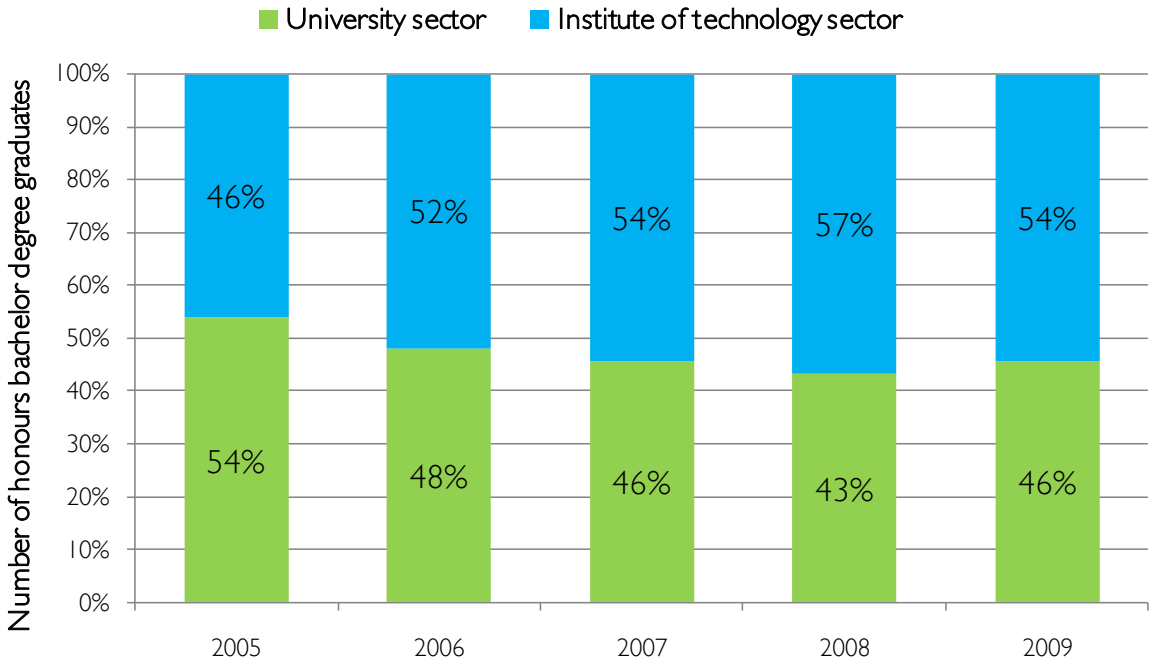


Figure 3: Number of Engineering, Manufacturing and Construction honours bachelor degree graduates by sector

Given the growth in the number of honours bachelor degree engineering programmes from the Institutes of Technology over the period from 2000 to 2008 and the associated rapid increase in the number of level 8 graduates, the Institutes were keen to understand how these graduates were progressing.

2.2 Research study objectives

Therefore, in 2009 the Institutes, supported by HETAC, commissioned a research study focused on the graduates of NFQ Level 8 programmes from the institute of technology engineering schools. The primary objectives of the study were to

- assess the preparedness of NFQ Level 8 graduates for their first job, and
- understand how the graduates were progressing in their careers.

Understanding the preparedness of institute of technology graduates for their first job included identifying the areas of the graduates' education that prepared them well for this first job and those aspects of their engineering programme that could be enhanced. The study also aimed to determine from engineering managers in the organisations that employ NFQ Level 8 engineering graduates which graduate skills are important and the employers' level of satisfaction with the skills of those graduates.

In addition, the research study was designed to learn how graduates are progressing in their career and if they have been given the roles and responsibilities expected of an engineer with

an NFQ Level 8 qualification. So the study aimed to determine which skills have been most relevant to the graduates in terms of their career progression and how their undergraduate education helped them attain those skills.

Finally, the research study aimed to create a baseline data-set on NFQ Level 8 engineering graduates from the Institutes. It is envisaged that this baseline will be used as a reference point in future studies, enabling the Institutes to continue to assess the progress of their graduates and to evaluate ongoing enhancements of engineering programmes.

A research study, designed to achieve these objectives, gathered information from NFQ Level 8 engineering graduates of the Institutes and from the organisations that employ engineering graduates from all higher education institutions. This study consisted of a series of surveys and focus groups of both the Institutes' NFQ Level 8 engineering graduates and senior engineering managers in organisations that employ engineering graduates.

The information gathered enables the Institutes to learn what elements of their NFQ Level 8 engineering programmes need to be enhanced to better prepare the graduate to meet the needs and expectations of employers.

2.3 Links with the National Strategy for Higher Education

While the research study was commissioned and mostly completed in advance of the publication of the *National Strategy for Higher Education*[7], the study does address three key recommendations of the strategy.

Under *Teaching and Learning*, the strategy recommends that "higher education institutions should put in place systems to capture feedback from students, and use this feedback to inform institutional and programme management, as well as national policy." (*Recommendation #2, p14*). This research study of NFQ Level 8 graduates of the Institutes' engineering schools constitutes a comprehensive feedback mechanism that has furnished rich and detailed information informing programme managers and academic staff within the Institutes.

With respect to *Engagement with the Wider Society* the strategy recommends that "a national survey of employers should be taken by the HEA on a regular basis and used as part of an assessment of quality outcomes for the system." (*#14, p18*). The survey and focus groups of the employers of NFQ Level 8 engineering graduates have provided valuable feedback to the Institutes on how they are preparing their students for a career in engineering.

[7] *National Strategy for Higher Education*, Report of the Strategy Group, January 2011

Finally in terms of a *Coherent Framework* the strategy recommends that "a framework should be developed to facilitate system-wide collaboration between diverse institutions." (*#19, p20*). This is the first research study to be conducted by the thirteen Institutes of Technology that graduate NFQ Level 8 engineering graduates. It represents a high level of collaboration between the Institutes and HETAC and has established a template for future joint studies.

2.4 Conclusion

The research study presented here represents a collaborative effort across thirteen Institutes of Technology that aims to capture feedback from the NFQ Level 8 engineering graduates of those Institutes and the organisations that employ those graduates.

The findings of this study will be used by academic staff in the Institutes to enhance programmes offered to their engineering students. It will directly guide the development of future engineering programmes and will influence how current programmes may be enhanced. Finally, the study has created a baseline set of data for NFQ Level 8 engineering graduates of the Institutes of Technology that will be used in future studies to assess developments in engineering education.

3 RESEARCH STUDY APPROACH

The research study consisted of the following four research elements which were conducted between 2009 and 2011:

1. A survey of almost 8,000 NFQ Level 8 graduates of institute of technology engineering schools, yielding 1,496 respondents;
2. A series of focus groups of graduates selected from those who had completed the graduate survey;
3. A series of focus groups of engineering managers from some of the organisations that employed these NFQ Level 8 graduates; and
4. A survey of engineering managers in more than 450 of the organisations that employ these NFQ Level 8 graduates, yielding 74 respondents.

3.1 Scope of the study

The scope of the research study was limited to the graduates of NFQ Level 8 programmes in the engineering schools of the Institutes listed on page 10 from 2000 to 2008. These graduates were invited to complete the survey and indicate if they were willing to participate in the follow-up focus groups. The graduates also provided information about the organisations in which they have worked since graduating. This information was used to select organisations invited to participate in the employer focus groups and the employer survey. The following sections summarise the approach for each of the research elements.

3.2 Timing of the study

The research for this study was conducted over the past two years, with the graduate survey conducted in early 2009 and the employer survey in late 2010 and the focus groups held in the interim. The most recent graduates included in the survey would have graduated in 2008 and the earliest as far back as 2000.

The responses from those people completing the employer survey were made at least 12 to 18 months later than the responses from the graduates. This period saw a significant decline in the economic situation in Ireland. Reuters listed some of the major events during this period in a November 2010 article entitled "*TIMELINE - Former 'Celtic Tiger' Ireland's economic woes*".

- 2009 March – Standard & Poor's downgraded Ireland's credit rating.
- 2009 April – The Government unveiled its second budget in six months.
- 2009 December – Budget included savings of €4B+ in public pay and welfare.
- 2010 July – Moody's cut Ireland's credit rating.
- 2010 August – Standard & Poor's cut Ireland's long-term rating.
- 2010 September – Cost of bailing out banks expected to be over €50B.

- 2010 November – The Government agreed an €85B rescue package with the EU/IMF.

As such the research covers a period of significant economic change. Some of the early graduates from 2000 and 2001 benefited from a number of years employment during the "Celtic Tiger" period while recent graduates from 2008 faced an economy that was beginning to falter.

3.3 Graduate survey

This graduate survey was designed to gather from graduates of NFQ Level 8 engineering programmes in the Institutes information about their education and how it prepared them for their career as an engineer. A separate online questionnaire was issued to the graduates of each Institute between December 2008 and March 2009 to explore graduates' views on their engineering education and their subsequent career progression under the following themes:

- Effectiveness of their education in preparing them for their first job;
- Career progression relative to graduates' expectations and other graduates;
- Importance of selected key skills for graduates in their career; and
- Suggestions on engineering programmes for the Institutes.

Graduates of 81 NFQ Level 8 programmes in the engineering schools of the Institutes during the years 2000 to 2008 were asked to participate in the survey[8]. A total of 1,496 graduates completed the thirteen questionnaires representing an overall response rate of approximately 19% of the almost 8,000 graduates invited to participate, as summarised in Table 1.

Table 1: Number of NFQ Level 8 programmes, graduates and responses by Institute

Institute	# of Programmes	# of Graduates	# of responses	Response Rate
AIT	9	438	96	22%
CIT	10	1,557	236	15%
DIT	16	1,715	278	16%
DkIT	2	343	79	23%
GMIT	5	545	105	19%
ITB	5	217	65	30%
IT Carlow	6	163	42	25%
IT Sligo	10	601	167	27%
IT Tralee	4	123	21	17%
ITT Dublin	3	282	59	21%
LyIT	2	124	47	38%
LIT	4	1,035	140	13%
WIT	5	822	161	19%
Total	**81**	**7,965**	**1,496**	**19%**

[8] The complete list of programmes is included in the appendix.

Table 2 presents the same data split by the discipline of the programme. Note that two Institutes included graduates of NFQ Level 8 architecture programmes in their individual survey. DIT graduates of built environment and computer science were not included in their survey.

Table 2: Number of NFQ Level 8 programmes and graduates by discipline

Discipline	# of Programmes	# of Graduates	# of responses	Response Rate
Architectural	2	95	25	26%
Chemical	1	256	38	15%
Civil	7	834	179	21%
Computer/Software	9	608	148	24%
Construction	15	2,243	359	16%
Electronic/Electrical	12	1,170	250	21%
Manufacturing	12	915	151	17%
Mechanical	20	1,737	329	19%
Transportation	3	107	17	16%
Total	**81**	**7,965**	**1,496**	**19%**

Figure 4 illustrates the variation within the survey responses by discipline across the Institutes. While the responses of NFQ Level 8 graduates from some Institutes are concentrated in one or two disciplines, the responses from graduates of other Institutes are spread across a range of disciplines.

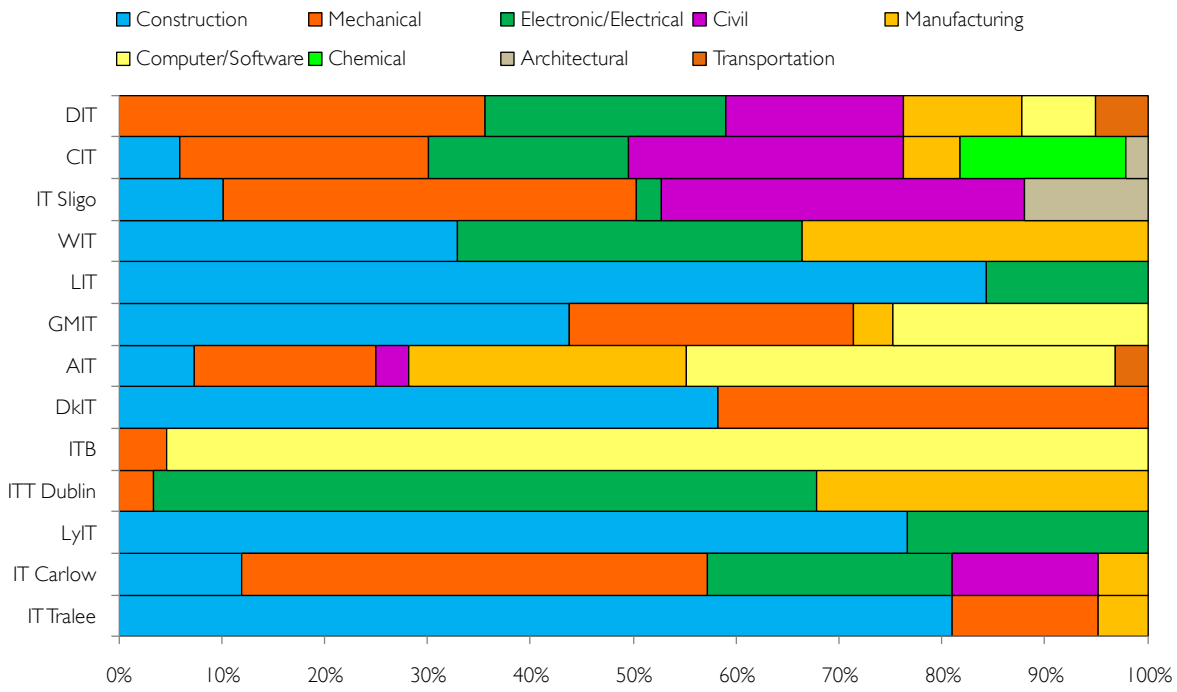


Figure 4: Variation in proportions of responses by discipline within each Institute

The responses from the thirteen separate NFQ Level 8 graduate surveys were amalgamated before being analysed for this report. As such, care should be taken when reviewing the data presented in this report as discipline profiles vary considerably between Institutes.

3.4 Graduate focus groups

The objective of hosting graduate focus groups was to further explore the views of institute of technology NFQ Level 8 engineering graduates about their education and career. Nine focus groups took place across the country during May and June 2010. Each focus group lasted 90 minutes, was held at an Institute of Technology on a workday evening and concentrated on the following main themes:

- Graduates' preparation for their first job;
- Career progression since graduating;
- Comparison to other engineering graduates;
- Suggestions for the Institutes; and
- Overall satisfaction with engineering as a career.

Participants of the focus groups were selected from respondents of the graduate survey who had indicated they were willing to take part in follow-on discussions. The focus groups were designed to include graduates of many Institutes across the following categories:

- Graduates who felt adequately prepared for their first job, split into two groups
    - those who graduated before 2007, and
    - those who graduated in 2007 or 2008; and
- Graduates of any year who felt inadequately prepared for their first job.

A total of 41 graduates participated in the focus groups, giving an average attendance of between four and five graduates per focus group. The following list show where the focus group participants worked and their current job titles.

- Accenture (Software Engineer)
- Acra Control Ltd (Software Engineer)
- Advantage Promotions (Director)
- An Garda Siochana (Guard)
- Analog Devices
- Test Development Engineer)
- Analog Devices (Applications Electronic Engineer)
- Arvato Financial Services (Audit & Compliance Specialist)
- Arvato Financial Services (Analyst Programmer)
- Atmel Ireland (Project Engineer)
- Intel (Manufacturing Technician)
- Irish Aviation Authority (Engineer)
- Irish Distillers (Vatting Technician)
- Irish Rail (Data Analyst)
- IT Tallaght (Associate Lecturer)
- Lawlor and Partners (Project Manager)
- Lough Glynn Development (Director/Manager)
- M50 D&C (Quality Engineer)
- Mayo County Council (Plant Manager)
- Murphy Environmental Hollywood Ltd (Landfill Facility Manager)
- Offaly Local Development Company

- Bruce Shaw Partnership (Senior Quantity Surveyor)
- Brunner Consulting Engineers (Civil/Structural Engineer)
- Churchfield Construction (Director)
- Colgate Palmolive (Technical Analyst)
- Digital River (Project Manager)
- Ericsson (Service Engineer)
- ESB (Station Asset Manager)
- ESB International (Design Team Leader)
- ESB Networks (Professional Engineer)
- Excel Industries (Design Engineer)
- (Asst Training Coordinator)
- Openet (Software Engineer)
- PM Group (Planner Scheduler)
- Railway Procurement Agency (Operations Manager)
- S3 Group (Software Engineer)
- Sea Power Ltd (Senior Development Engineer)
- Systems Dynamics (IT Administrator)
- Uniphar PLC (Engineering Manager)
- Ward & Burke Construction Ltd (Site Engineering/Agent)

3.5 Employer focus groups

The employer focus groups aimed to explore employer perspectives of the NFQ Level 8 engineering graduates hired by organisations. The focus groups were conducted during the months of October, November and December 2009. Each focus group lasted 90 minutes and covered the following main themes:

- Preparation of NFQ Level 8 engineering graduates for their first job;
- Expectations for and progression of NFQ Level 8 engineering graduates;
- Research and innovation and workforce upskilling;
- Graduate hiring trends; and
- Suggestions for the Institutes.

A focus group was held for organisations from each of nine sectors as shown in Table 3 which also lists the organisations represented in each focus group. The invitation lists for the focus groups were drawn from the organisations identified by respondents to the NFQ Level 8 graduate survey and from lists provided by each Institute of Technology.

Table 3: Focus group sectors and participating organisations

Sector	Organisations represented in the focus group	
Software & IT Services and Telecommunications	Accenture (x2) Eircom Ericsson	IBM O2 Ireland SAP
Local Authority & Other Public Sector	Alstom Ireland Fingal County Council Dublin City Council	Kildare County Council Meath County Council South Dublin County Council
Engineering Consultancy	Arup DBFL Consulting Engineers ESB International	J.B. Barry & Partners PM Group
Construction	Balfour Beatty	Sisk

Sector	Organisations represented in the focus group	
	BAM Contractors	Wills Bros Ltd
	Bennett Construction Ltd	
Medical Devices Manufacturing	Allergan Pharmaceuticals (x2)	Medtronic
	Boston Scientific	USCI Ireland
Pharmaceuticals & Bio-tech Manufacturing	Corden PharmaChem	Pfizer
	Eli Lilly	Schering Plough
	Glaxo Smithkline	Zenith Technologies
Electronic Systems & Hardware Manufacturing & IC Design	Analog Devices	Tyndall
	Kostal Ireland GMBH	
Other Small and Medium sized enterprises	Ardmac	GEA Process Technologies
	Anord Control Systems	Lotus Technical Services
Other Manufacturing and Services	Bord Gais Networks	Electrical & Pump Services Ltd
	Cameron	

The focus groups were held at Institutes of Technology and 44 experienced individuals from the organisations listed above participated in the discussions. On average, the participants had a career to date of almost 23 years and had been with their current employer for an average of approximately 12.5 years. Almost 80% of participants held manager or director titles in the organisation and almost 85% of participants had engineering responsibilities.

3.6 Employer survey

The objective of the employer survey was to gather information from employers about the following three main topics:

- Preparedness of NFQ Level 8 engineering graduates for their first job;
- Importance to employers of certain skills and their satisfaction with the graduates' level of attainment of those skills; and
- The progression of institute of technology NFQ Level 8 engineering graduates relative to their university peers and how they meet employers' expectations.

Engineering managers and managing directors from more than 450 organisations identified in the NFQ Level 8 Graduate Survey and from lists provided by the Institutes were invited to complete the survey during the second half of 2010. When the online survey was closed in December 2010, there were 74 responses to the survey from individuals in the organisations listed in Table 4, representing a response rate of 16% of those invited to complete the survey.

Survey respondents are experienced, have been with their current employer for an average of at least 12 years. Over 80% have manager, vice president or director roles. The organisations

listed below hired just over 1,600 engineering graduates over the period from 2007 to 2009 and employ an estimated 5,000 plus engineers in Ireland.

Table 4: Organisations represented in the employer survey responses

Sector	Organisations	
Engineering Consultancy	Arup Consulting Engineers	Jennings O'Donovan & Partners
	CPD	LotusWorks
	ESB International	Modular Automation Ireland Ltd
	G. Sexton & Partners	PM Group
	GEA Process Technologies Ireland Ltd.	Prochem Engineering
Software & IT Services	Cisco Systems	Microsoft
	EMC	OpenJaw Technologies
	IBM	Pramerica Systems Ireland
	IES Ltd	Limited
	IT Force	SAP SSC Ireland
Electronic Systems & Hardware Manufacturing	Alps Electric (Ireland) Ltd	Intel Ireland
	Analog Devices	M/A Com Technology Solutions
	EMC Information Systems International	Multis Ltd
	EMC Ireland	Sennheiser
	Flextronics	
Pharmaceutical & Bio-tech Manufacturing	Bristol-Myers Squibb	Schering-Plough
	GSK	Schwarz Pharma
	Novartis Ringaskiddy Ltd	Servier Industries Ltd.
	Pfizer Ireland Pharmaceuticals	
Medical Devices Manufacturing	Baxter Healthcare	Medtronic
	Creagh Medical	Stryker Ireland
	DePuy, Johnson & Johnson	
Construction	Ardmac Ltd	EPS Pumping & Treatment
	Coffey Construction	Systems
	CRH	Kingspan
	ECI JCB	PJ Carey Contractors Ltd.
Telecommunications	E-Net	Intune Networks
	Ericsson Ireland	O2 Ireland
Utilities	Bord Gais Networks	ESB
	Bord na Mona Energy	
Local Authority	Cavan County Council	Kildare County Council
	Clare County Council	Offaly County Council
	Donegal County Council	South Tipperary County Council
	Dun Laoghaire Rathdown County Council	Waterford County Council
	Fingal County Council	Westmeath County Council
	Galway County Council	
Other	Anord Control Systems	Ingersoll Rand
	D&S Machinery Ltd	Keenan's
	Dromone Engineering Limited	Multihog Ltd

4 Key Research Findings

This report draws together the findings that emerged from the four research elements described in Chapter 2 – the graduate survey and focus groups as well as the employer survey and focus groups. The findings are presented in turn in each of this chapter's sub-sections under the following 11 themes.

1. Graduate preparation for their first job and their career.
2. Graduate career progression.
3. Importance of non-technical skills such as oral and written communication.
4. Graduate views on the effectiveness of their education.
5. Employer satisfaction with graduate skills.
6. Additional training provided by employers.
7. Graduate views on the perceptions of an institute of technology engineering qualification.
8. Graduate recommendations of their programme, Institute and career.
9. Industry views of the Institutes.
10. Suggestions and recommendations for the Institutes.
11. Topics meriting further exploration.

4.1 Graduate preparation

A key objective of the overall research study was to determine how well the education and training provided by the Institutes prepared their NFQ Level 8 engineering graduates for their first job and their career.

4.1.1 Graduates' views on preparation for their first job

Overall the research found that more than four in five NFQ Level 8 graduate respondents stated that their education prepared them adequately for their first job. In addition, at least four in five employer respondents found graduates to be adequately prepared in terms of their technical and practical skills.

Figure 5 presents a summary of graduate respondents views on whether they felt their education adequately prepared them for the role required by their first job. It shows that 83% of the graduate respondents felt adequately prepared. The percentages of respondent holding that view varied by engineering discipline from 78% for graduates of computer/software programmes to 87% for graduates of chemical and manufacturing disciplines[9].

[9] The data for architecture and transportation disciplines are not included in this and similar charts given the low number of responses in these disciplines.

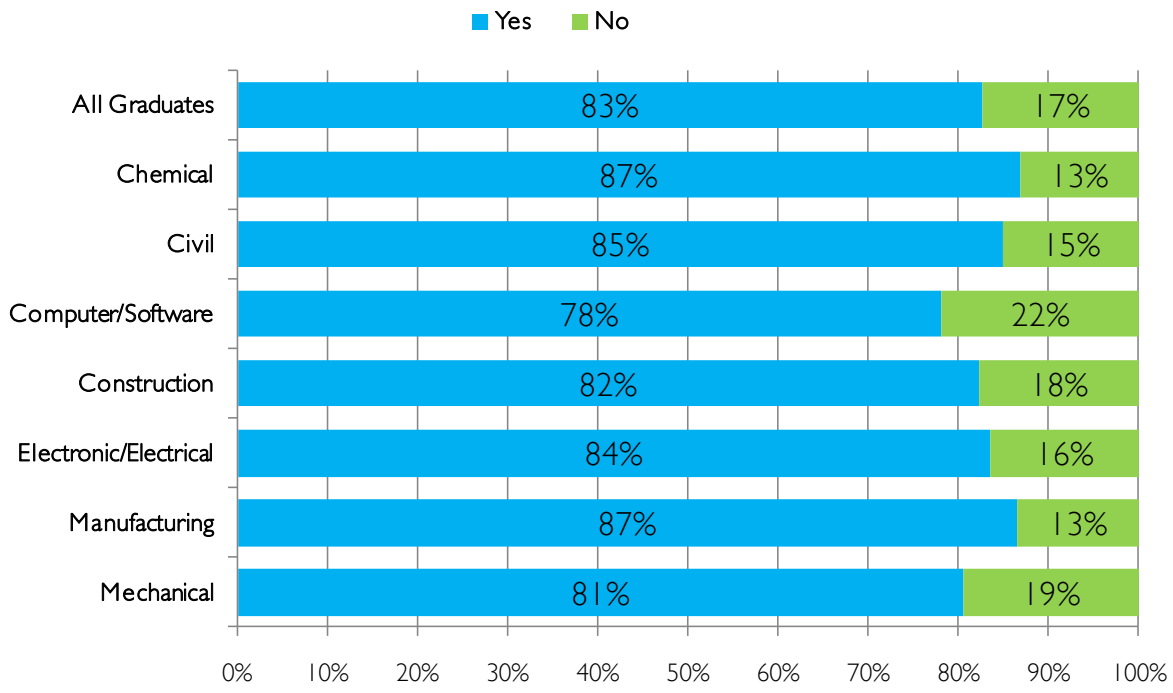


Figure 5: Graduation preparation for first job - by discipline

Figure 6 provides an illustration of the spread in responses across the different Institutes. Starting with the uppermost bar, the bars signify the distribution of responses across:

- all 13 Institutes;
- the Institute with the highest percentage of graduates who felt adequately prepared for their first job (*Max Institute*);
- the Institute with the median percentage level (*Median Institute*); and
- the Institute with the lowest percentage of graduates who felt adequately prepared for their first job (*Min Institute*).

While the chart is presented to show the spread across the Institutes, it would be simplistic to compare Institutes given the disparity between the Institutes across a number of dimensions, including the following:

- the number of graduate respondents varies significantly by Institute from a minimum of 21 to a maximum of 278 – see Table 1 on page 16;
- the number of years since each graduate left full time education varies given that some Institutes only started producing these graduates in 2004 – see Figure 2 on page 11; and
- the disparity in the disciplines represented by the respondents from each Institute as well as the number of respondents in each discipline as shown in Figure 4 on page 17.

While there is some variation across Institutes in the chart, the Institutes are clustered quite closely together with the percentage of graduates who feel that their education adequately prepared them for their first job ranging from a minimum of 78% to a maximum of 90%.

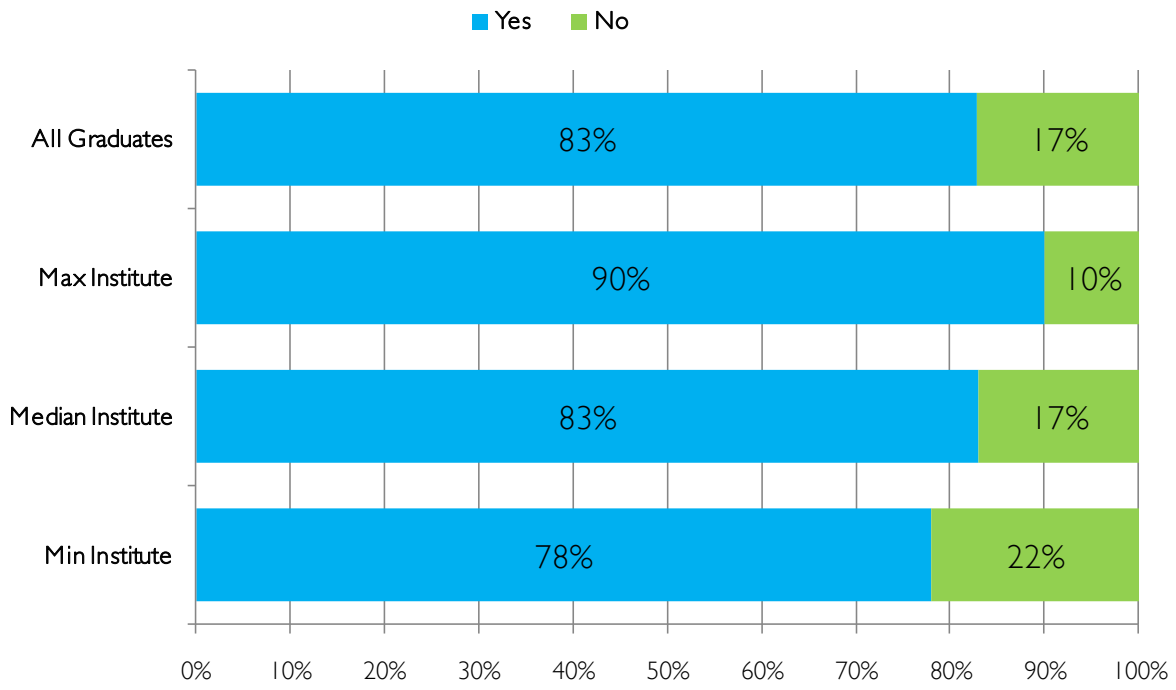


Figure 6: Graduation preparation for first job - by Institute

Recognising that 17 percent of graduates did not feel adequately prepared is something to understand and reflect upon, two of the graduate focus groups were designed to explore the issues of those graduate respondents. The following three themes emerged in those particular focus groups:

- Some graduates, particularly computer/software graduates from the middle of the last decade, found that there was a lack of jobs that matched their skills and the areas in which they had specialised.
- Some graduates felt that their particular Institute did not provide adequate career guidance or enough support as they searched for their first job. A number of these graduates felt that they were unprepared for interviews when they graduated.
- Some graduates noted that there was no work placement as part of their programme and that they felt potential employers were looking to hire graduates with such work experience.

4.1.2 Views of graduates on preparation for a fulfilling career

Four in five respondents to the graduate survey agreed with the statement that "*my education prepared me for a fulfilling career*". Figure 7 shows that 81% of the graduate respondents agreed with the statement and that the highest level of agreement was with graduates of the civil engineering discipline (87%) and lowest for the computer/software discipline (76%).

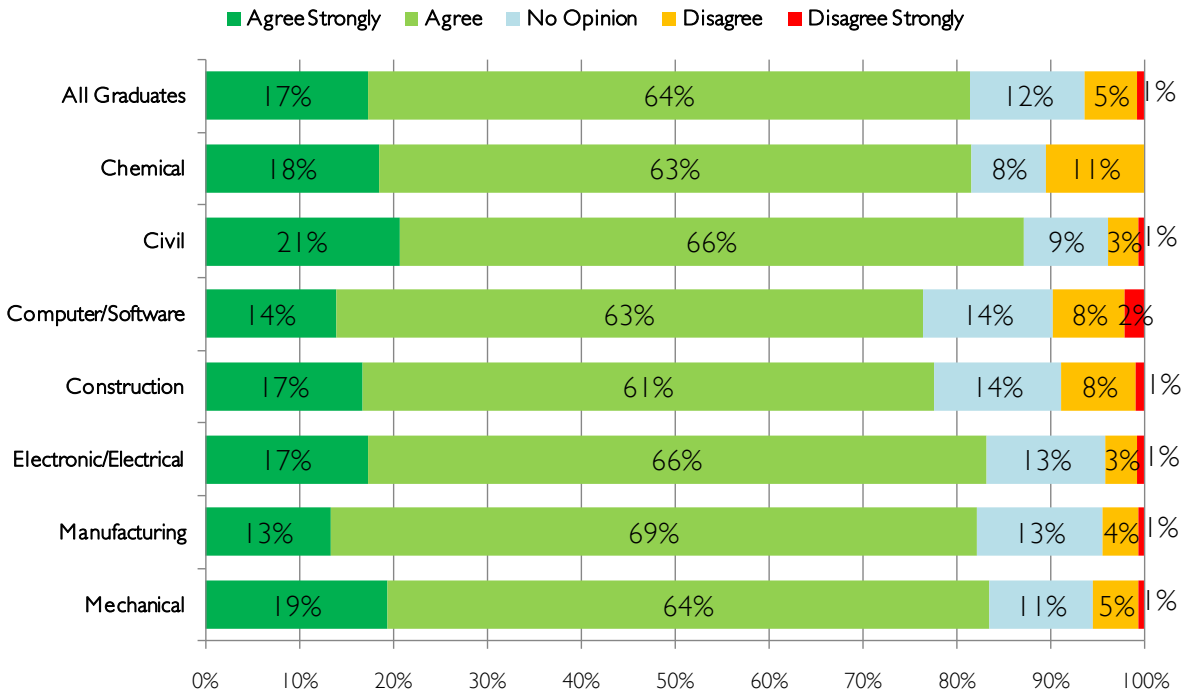


Figure 7: Agreement by discipline with statement: "My education prepared me for a fulfilling career."

There was some variation by institute as the level of agreement ranged from 71% of graduates in the Institute with the lowest level to 91% for the highest – see Figure 8. That said, for the "*Min Institute*" a relatively high proportion (33%) of graduates actually agreed strongly with the statement. This proportion is actually higher than for the "*Max Institute*". This may indicate that the sources of disagreement for the "*Min Institute*" are due to factors such as the content of a specific programme, the level of career guidance support provided or the availability of jobs for the students on graduation.

Again, while the following chart is presented to show the spread across the Institutes, it would be simplistic to compare Institutes given the disparity between Institutes in terms of the number of responses, the disciplines and the number of years since graduation.

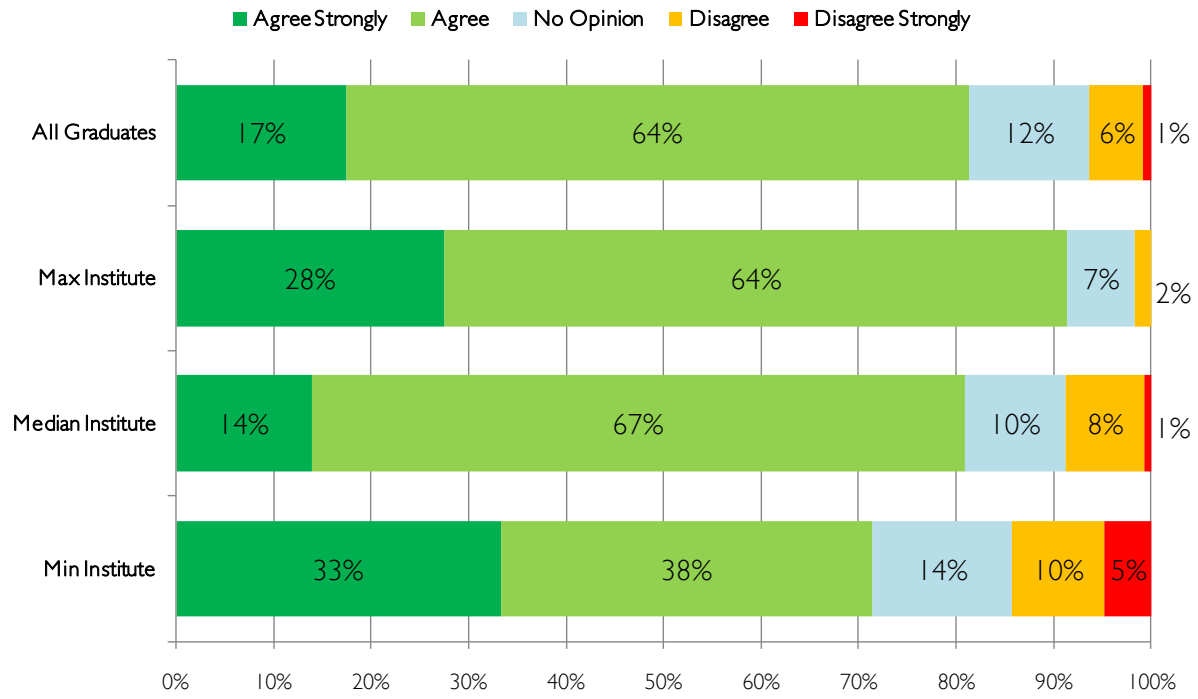


Figure 8: Agreement by Institute with statement: "My education prepared me for a fulfilling career"

4.1.3 Views of employers on graduates' preparation

In general, employer respondents felt that the graduates they have hired were well prepared or prepared for their first job in terms of technical and practical engineering skills but over one third of employer respondents felt that engineering graduates they selected were under-prepared in terms of non-technical skills such as oral and written communication.

Respondents to the employer survey were asked to rate the preparation of NFQ Level 8 engineering graduates from various higher education institutions for the role of their first job across the following six areas:

- Technical engineering skills;
- Practical engineering skills;
- Problem solving skills;
- Non-technical or generic skills[10];
- Attitude; and
- Understanding and commercial awareness.

Figure 9 shows that more than 4 out of 5 respondents to the employer survey found graduates of the Institutes to be either well prepared or prepared[11] in terms of their technical skills and their attitude to work.

[10] These non-technical or generic skills include skills such as oral and written communications, interpersonal skills and teamwork.

Technical engineering skills refer to the graduates' engineering knowledge in their field such as civil, electronic or mechanical, while attitude referred to characteristics of the graduates such as their willingness to work and time-keeping.

Similar proportions of respondents found the graduates prepared in terms of practical engineering skills such as computer applications and laboratory skills and problem solving skills such as critical/analytical thinking and creativity/innovation.

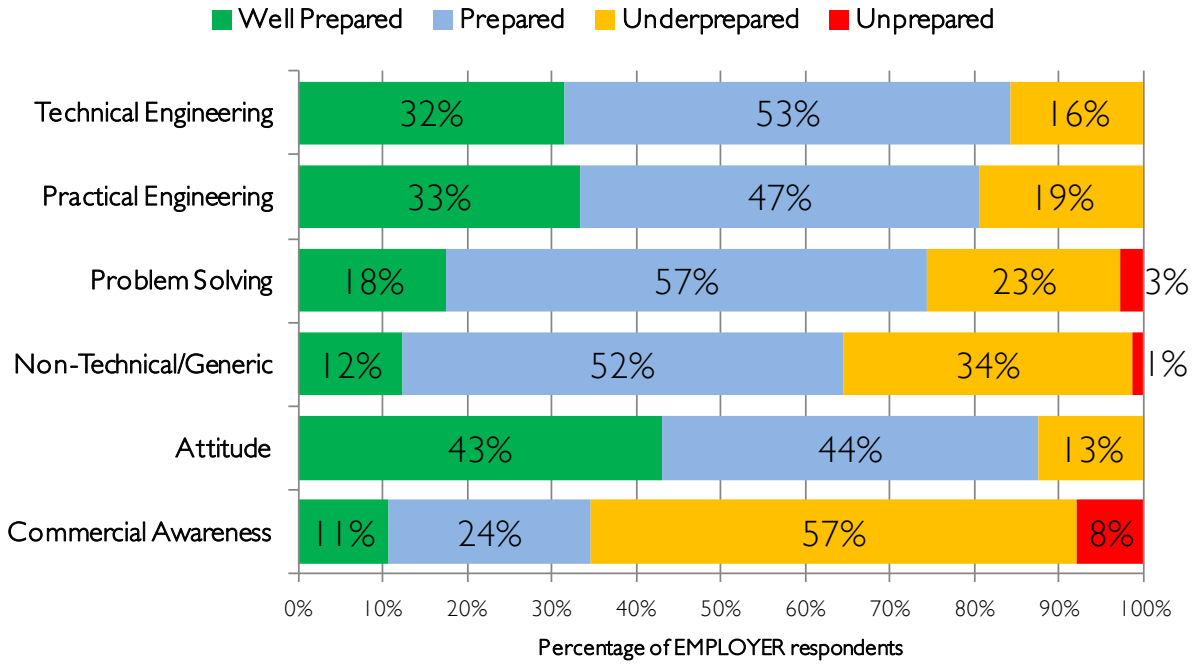


Figure 9: Employers' views of preparedness of institute of technology graduates - by skill

NON-TECHNICAL/GENERIC SKILLS

Employer respondents found that, in general, NFQ Level 8 engineering graduates of all institutions need to be better prepared in their non-technical skills such as communication and teamwork. Only 64% of respondents found graduates of the Institutes to be prepared in these areas.

Participants in the employer focus groups commented on the need for engineering graduates from all higher education institutions to have better oral and written communications skills and experience of teamwork. Some of the participants found that graduates very often have poor written skills with some weak on structuring business emails and written reports.

[11] Response options for these questions were; *Well Prepared*: Little or no guidance needed, *Prepared*: Expected level of guidance/introduction/supervision needed, *Underprepared*: More than expected guidance was required, and *Unprepared*: Evidence of knowledge/skill not demonstrated.

Focus group participants also noted that graduate engineers have to deal with a wide range of people in their job including fellow engineers, manual workers, their supervisor or manager, and clients. Clearly being able to talk and listen effectively to these varied groups of people is an important skill for graduate engineers.

Participants noted that some graduates performed poorly when they were required to stand up and present their ideas to a group of peers or managers. It was suggested that presenting to groups should be part of all engineering curricula from the student's first year.

Commercial Awareness

Employer survey respondents indicated that only some graduates understood the activities of the organisation they joined, how engineers contributed to its operation and affected its financial performance. Only 35% of respondents found graduates of the Institutes to be prepared in terms of their commercial awareness.

Participants in the employer focus groups also commented that many engineering graduates, of both the Institutes and the Universities, have a limited understanding of what it means to be an engineer in a company and are unclear about the *raison d'être* of the organisation they have joined – for example, the commercial realities of projects in construction or engineering consultancy or the political realities of the public sector.

Anecdotally, some participants noted that they felt graduates failed to realise that their work is no longer going to be treated as a classroom exercise and that "a passing grade is not going to be good enough in the commercial world". At least one participant in each focus group commented on graduates presenting for interview with a limited knowledge about the activities of the company.

4.2 Graduate progression

The careers of almost 7 out of 10 institute of technology graduates are progressing well in relation to the graduates' own expectations. Four out of ten graduate respondents have obtained additional academic or professional qualifications since graduating. Employer respondents are happy with the progression of institute of technology graduates with more than 9 out of 10 employers noting that these graduates either meet or exceed their employers' expectations.

4.2.1 Graduate views on career progression

The graduates were asked to indicate their level of agreement with the statement "*my engineering career and associated salary has progressed as I expected since graduating*" and Figure 10 shows that 65% of graduate respondents believe their careers are progressing as expected.

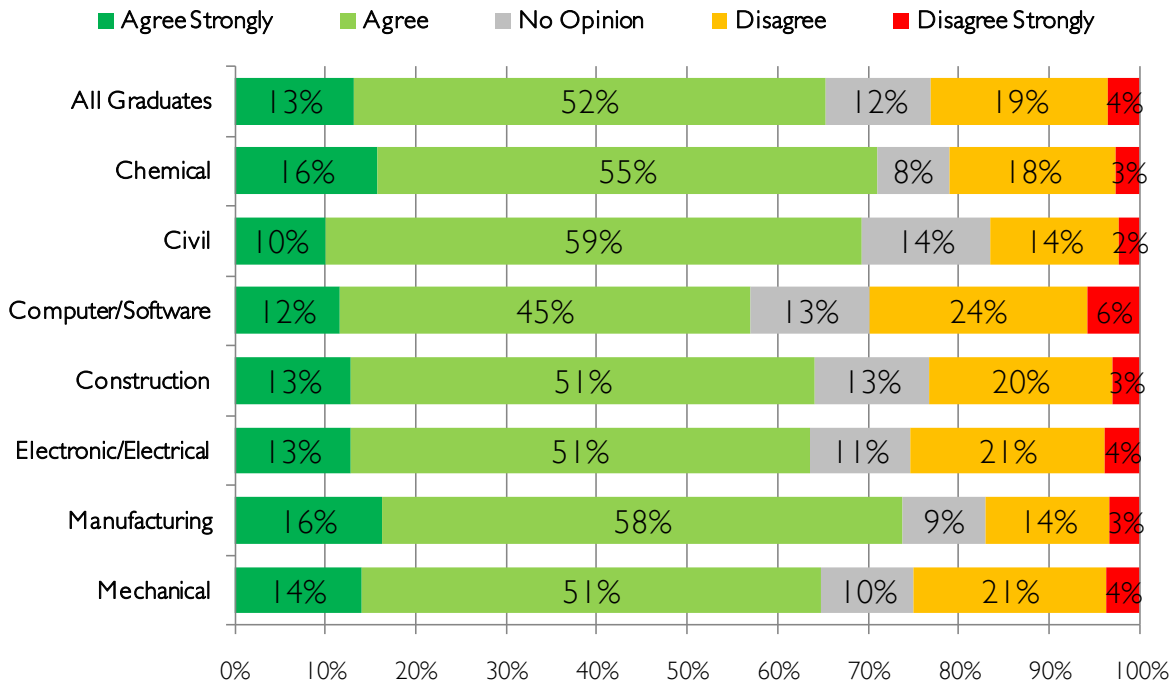


Figure 10: Agreement by discipline with statement "My engineering career and associated salary have progressed as I expected since graduating"

Graduates of the manufacturing, chemical and civil engineering disciplines had the highest levels of agreement at 74%, 71% and 69% while graduates of computer/software programmes had the lowest level of agreement at 57%. Figure 11 shows the variation in the graduates' responses by Institute and the levels of agreement range from 54% to 72%.

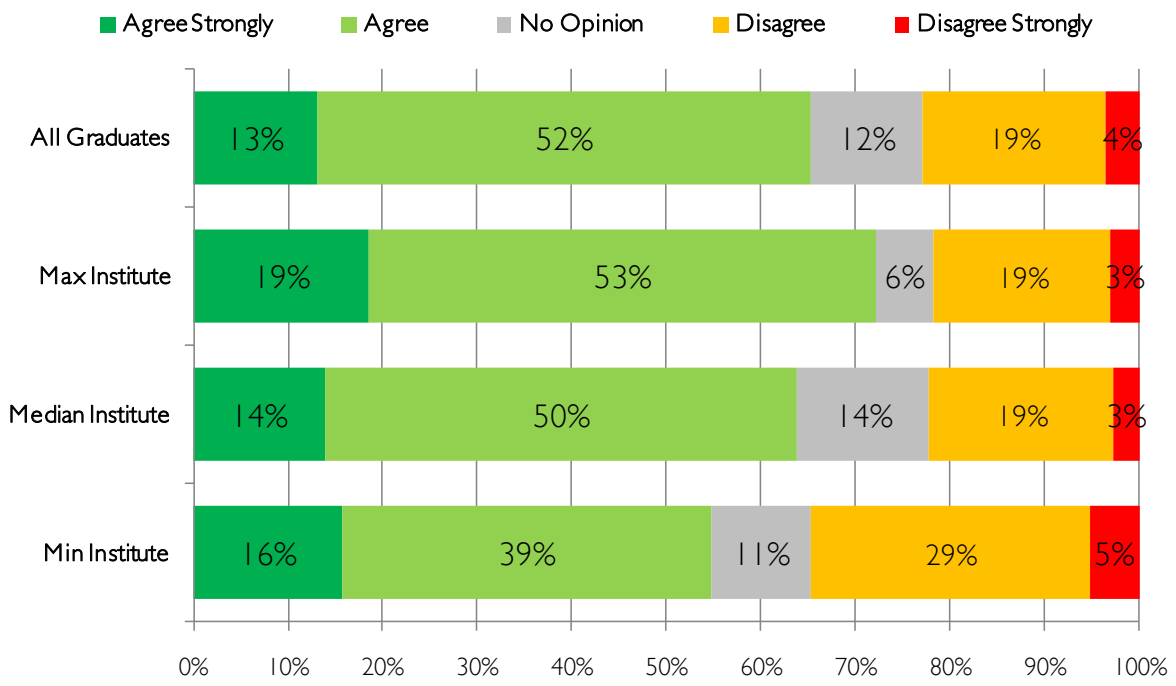


Figure 11: Agreement by Institute with statement "My engineering career and associated salary have progressed as I expected since graduating"

4.2.2 Graduate views on responsibilities

Almost 8 out 10 NFQ Level 8 graduate respondents of the Institutes believe that they have been given appropriate engineering responsibilities. Figure 12 shows the graduates' level of agreement with the statement that "*my employers have given me the responsibilities and tasks corresponding with my engineering qualifications*".

The graduates of civil and chemical engineering programmes had the highest levels of agreement at 82% and 81% respectively. While graduate respondents of the computer/software and electronic/electrical engineering disciplines had the lowest level of agreement, this was still over 70% in both cases. Figure 13 shows the variation in agreement by Institute which ranges from 64% to 86%.

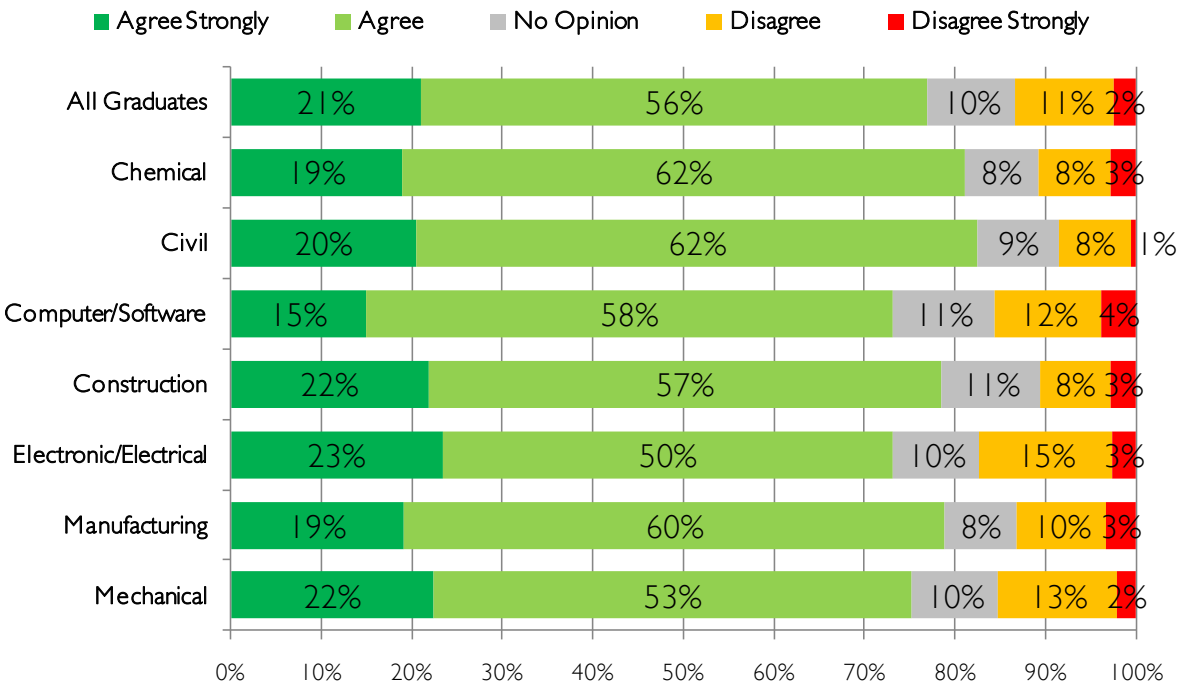


Figure 12: Agreement by discipline with statement "My employers have given me the responsibilities and tasks corresponding with my engineering qualifications"

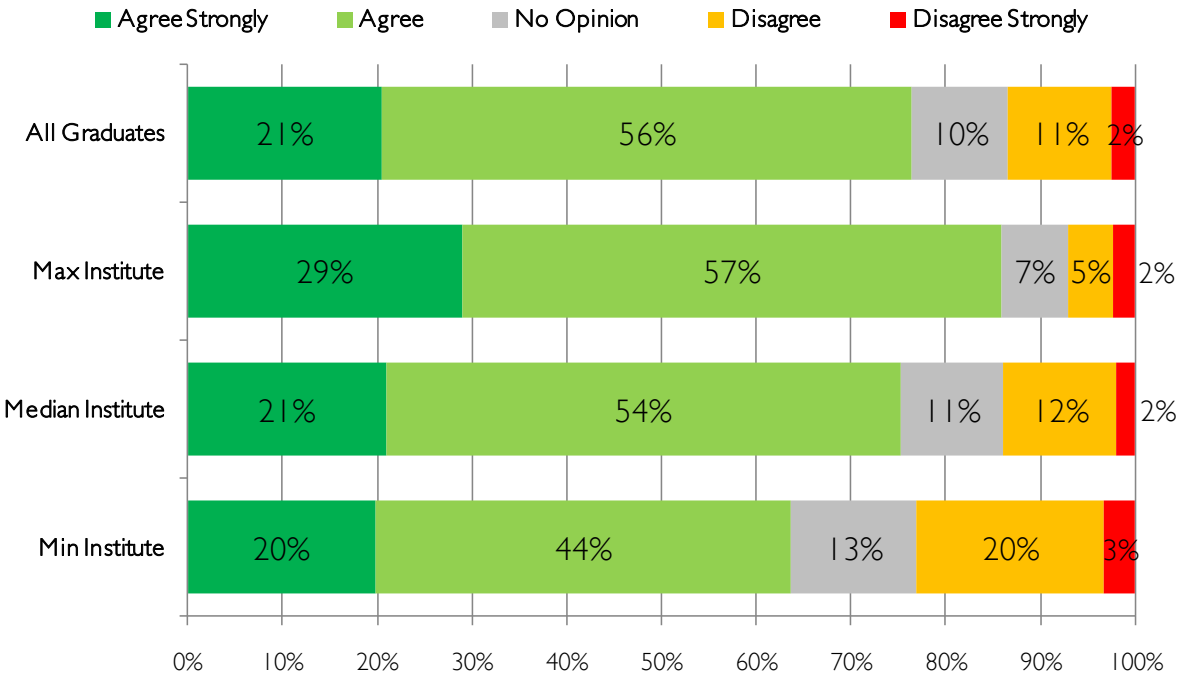


Figure 13: Agreement by Institute with statement "My employers have given me the responsibilities and tasks corresponding with my engineering qualifications."

All graduates who participated in the focus groups felt they are being given the roles and responsibilities they expected to be given to a NFQ Level 8 engineer and the majority of participants felt that their overall compensation had progressed as they would have expected.

Some graduates said that due to the recent economic circumstances they have had to take jobs for which they may have been overqualified while a number of construction graduates acknowledged the impact of the economic downturn on their careers.

4.2.3 Postgraduate qualifications

Almost 2 out of 5 of the Institutes' graduate respondents either obtained or were pursuing an additional academic or professional qualification as shown in Figure 14.

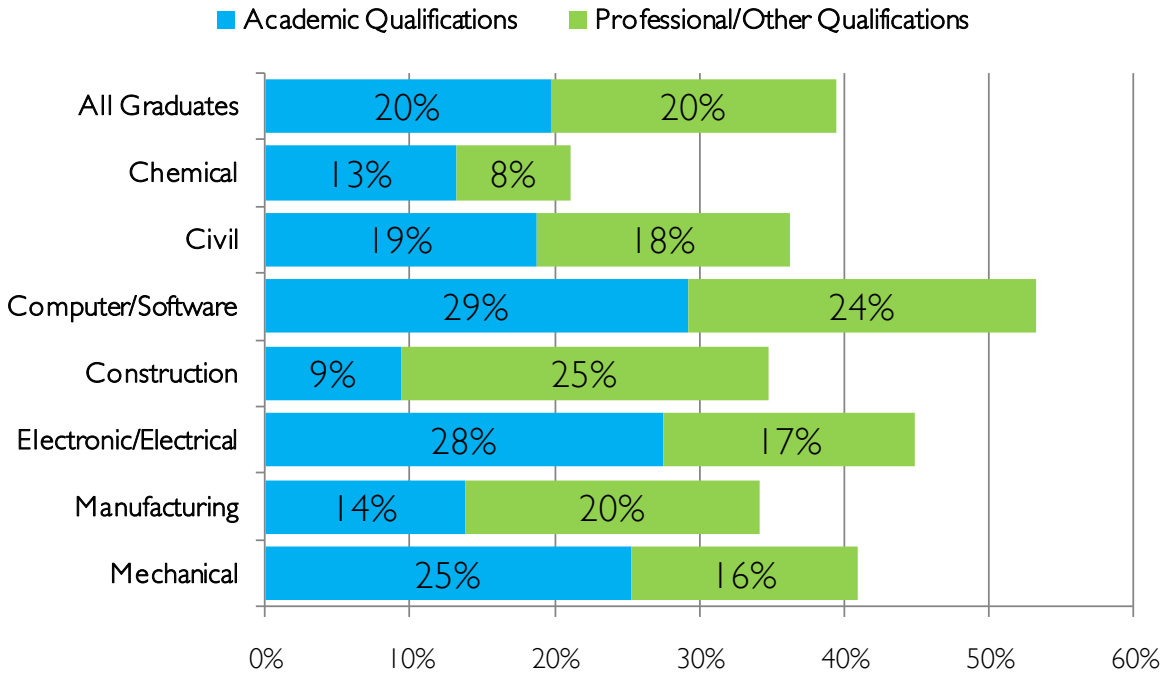


Figure 14: Percentage of graduate respondents who are pursuing or have obtained additional qualifications

Figure 15 illustrates the types of academic qualifications that have been obtained or were being pursued by the 20% of the graduate respondents in the uppermost bar in Figure 14. Almost two thirds of these graduate respondents have obtained or were pursuing a Masters degree.

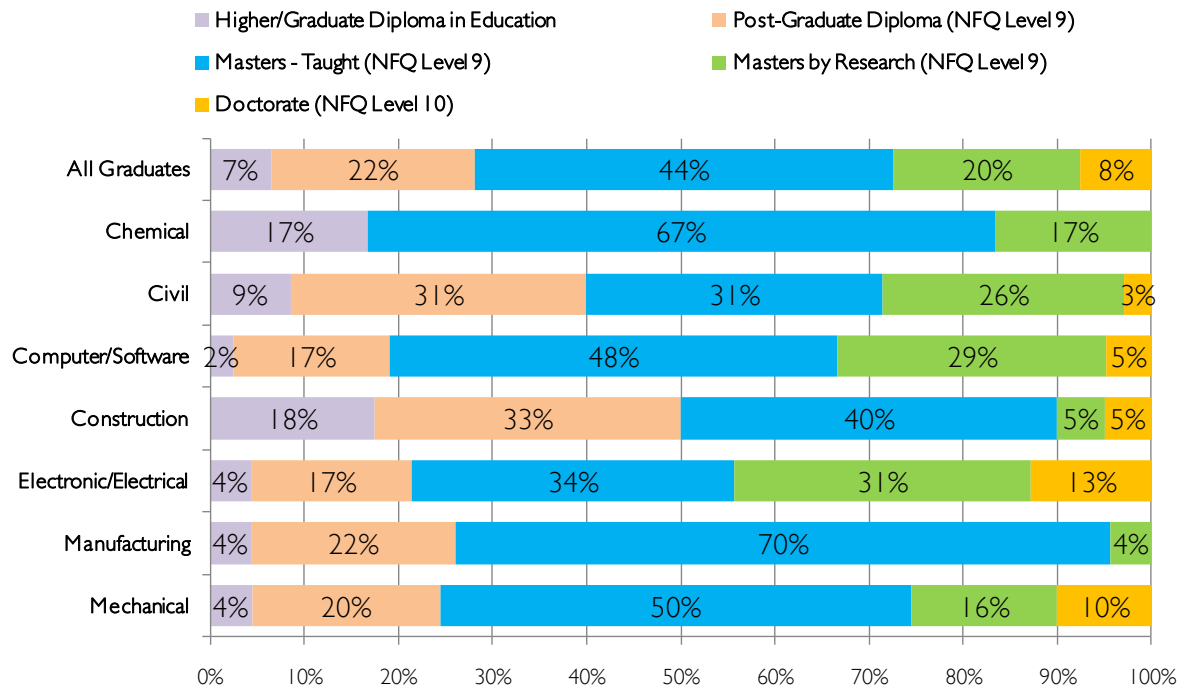


Figure 15: Academic qualifications pursued by graduates

4.2.4 Employer views on meeting expectations and progression

More than 9 out of 10 of the respondents to the employer survey felt that graduates of the Institutes meet or exceed the expectations of their employer. As shown in Figure 16, these respondents see similarity between institute of technology and university graduates in terms of meeting expectations.

The employer focus groups did not find any examples of differences in expectations for NFQ Level 8 graduates from the Institutes and those from other institutions. All participants in the focus groups had hired qualified graduates for specific roles and were not concerned if the engineers had graduated from a university or an institute of technology.

Around 8 out of 10 respondents to the employer survey found that institute of technology NFQ Level 8 engineering graduates are progressing at a similar rate in their careers as other graduates, as shown in Figure 17.

Participants in the employer focus groups commented that institute of technology graduates are progressing as expected in their first year and over the next 3-5 years. They noted that there is no appreciable difference between their progression and that of the university graduates. In general, all participants found that progression tends to depend more on the capabilities of the individual engineer rather than on the person being a graduate of a university or an institute of technology. Many of the employer focus group participants noted that their senior management team included institute of technology graduates.

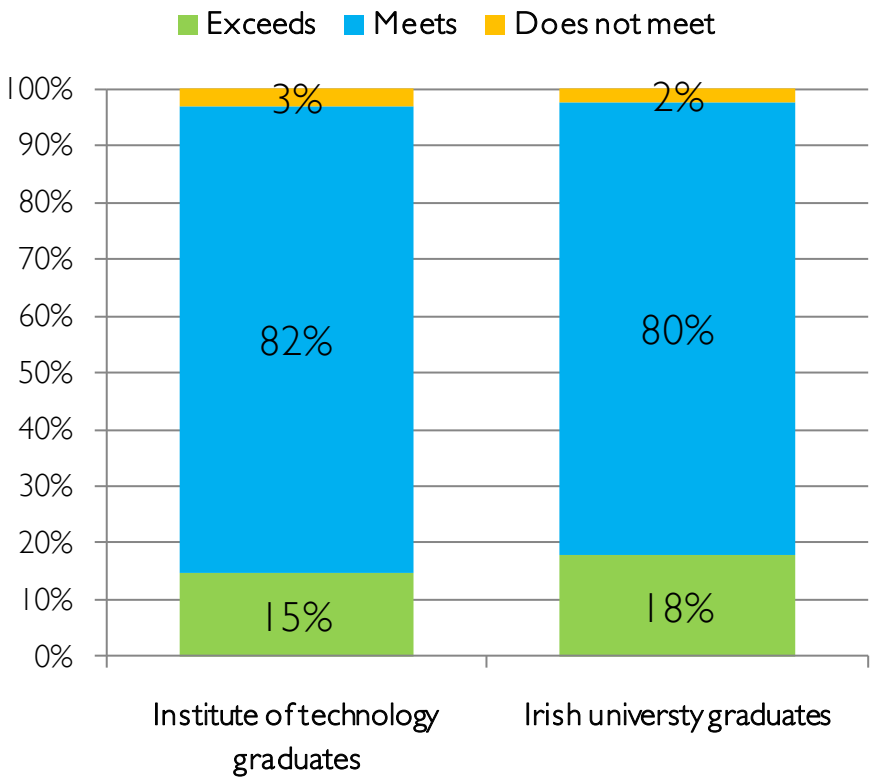


Figure 16: Employer views of how graduates meet expectations

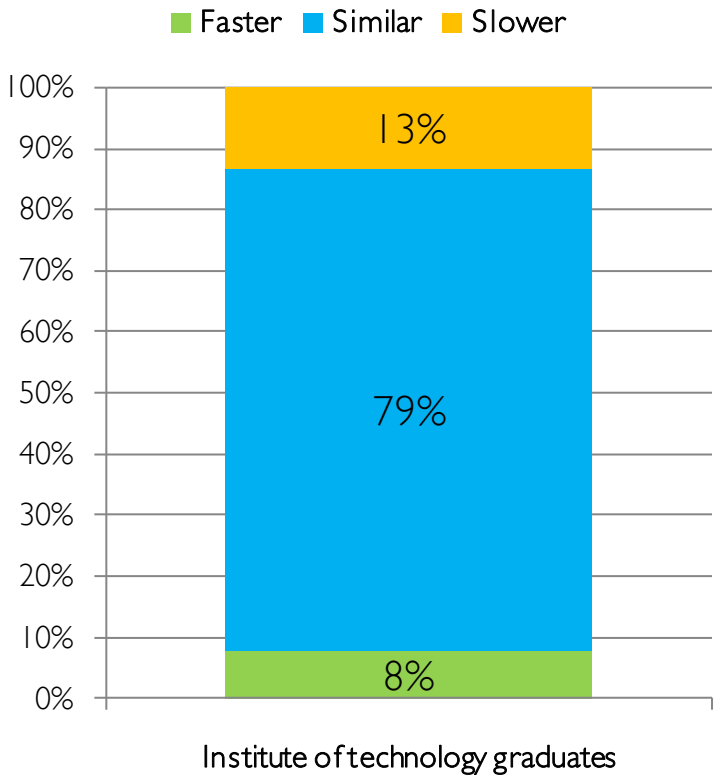


Figure 17: Employer views on career progression relative to university graduates

All participants in the graduate focus groups believed that all NFQ Level 8 engineering graduates are viewed similarly, whether they graduated from an institute of technology or a university. It was noted in each of the graduate focus groups that some companies prefer to hire graduates of the Institutes as these graduates may have more practical experience from a work placement or may be considered as more immediately productive given that the number of classroom hours is perceived to be higher in institutes of technology than in a university.

Graduates also noted in the focus groups that having a NFQ Level 8 degree is becoming more important for career progression. Employers are generally aware of the differences between NFQ Level 7 and NFQ Level 8 degrees and more frequently the possession of a NFQ Level 8 degree is a requirement for promotion. Furthermore, in sectors such as civil engineering and construction where tenders for work require the inclusion of CVs or educational details on all personnel who will be involved on the project, there is a very important requirement for as many people as possible, if not everyone, to have a NFQ Level 8 qualification at a minimum.

4.3 Importance of key skills

Certain key skills were identified by both graduate and employer respondents as being important for NFQ Level 8 engineering graduates in order to progress in their careers. Figure 18 shows the relevance of a range of skills to the graduates' career ranked in order of importance. It ranges from critical thinking/analytical skill at the highest level which was ranked essential by 76% of graduates to fluency in another language at the lowest which was only ranked essential by 4% of graduates.

Figure 19 shows the views of employer respondents on the importance of the skills held by NFQ Level 8 engineering graduates, again ranked in order of importance. The most important skill is technical engineering which was ranked essential by 98% of survey respondents and the least important again was fluency in a foreign language which was only ranked essential by 2% of respondents.

The scatter plot (Figure 20) compares the importance of the following 13 skills that were common in the graduate and employer survey.

- Technical Engineering
- Written Communication
- Oral Communication
- Teamwork
- Critical/Analytical thinking
- Interpersonal
- IT
- Creativity/Innovation
- Leadership
- Management
- Research
- Business/Entrepreneurial
- Foreign languages

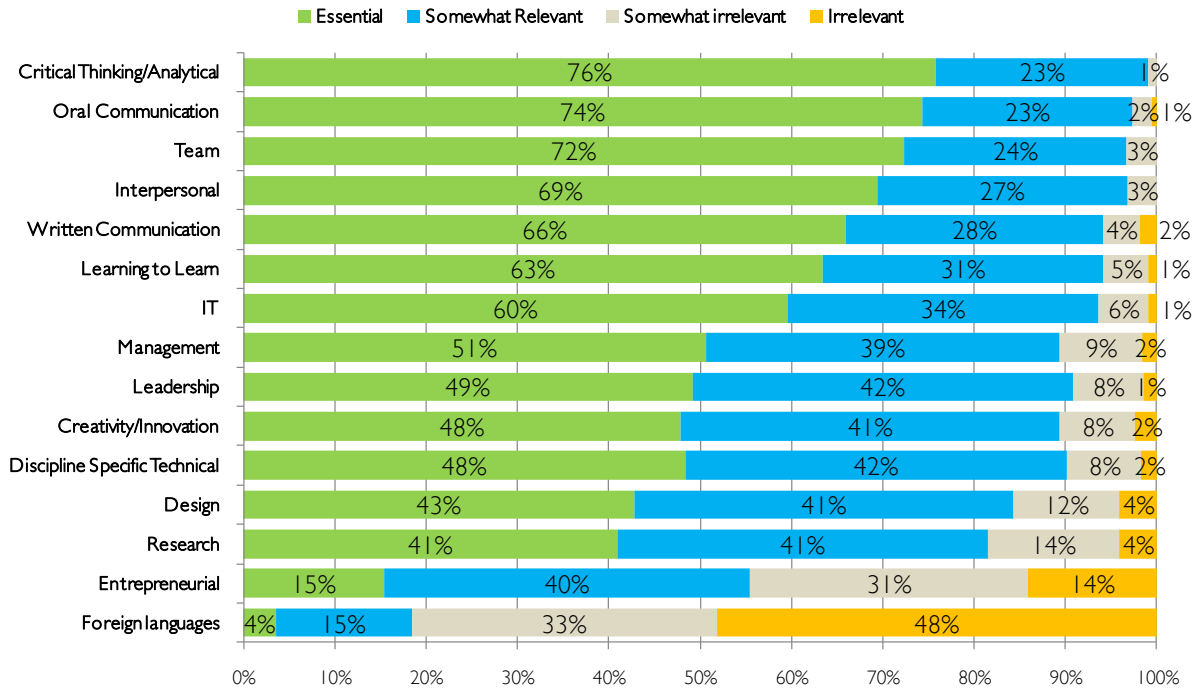


Figure 18: Graduates' views on the importance of skills

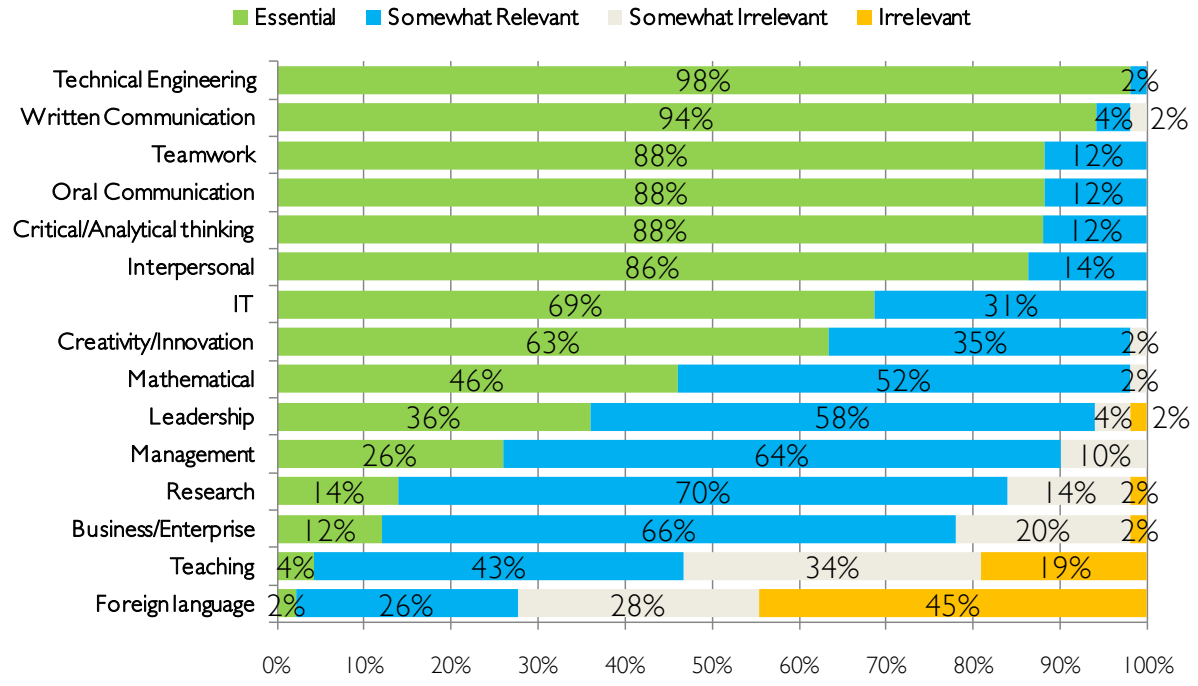


Figure 19: Employers' views on the importance of skills

Points above the diagonal line show skills which graduates saw as more important than employers. Points below the line show skills which employers saw as more important than graduates.

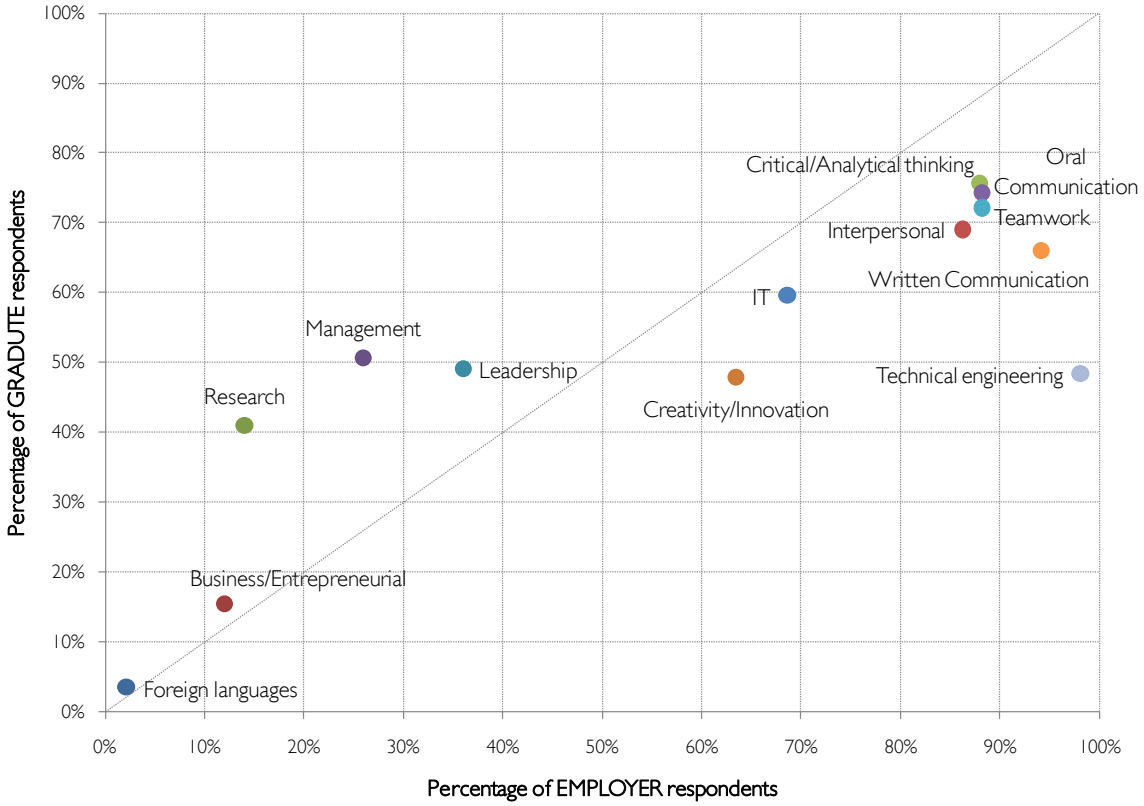


Figure 20: Comparison of employer and graduate respondent views on the importance of skills

Figure 20 shows that both the graduate and employer respondents rated critical/analytical thinking very high in terms of importance as well as a number of non-technical skills such as oral and written communication, teamwork and inter-personal skills.

It is interesting to note that a higher proportion of employer respondents ranked the skills in Table 5 as important when compared with the graduate respondents.

Table 5: Importance of key skills to employers and graduates

Skill	Employers	Graduates
Technical engineering	98%	48%
Written Communication	94%	66%
Oral Communication	88%	74%
Teamwork	88%	72%
Critical/Analytical thinking	88%	76%
Interpersonal	86%	69%

In particular, the two most important skills for employers are technical engineering considered essential by 98% of respondents and written communication skills (94%). However, the proportions of graduate respondents ranking these skills as important are not as high. Technical engineering skills were ranked important by 48% of graduate respondents vs. 98% of employer respondents.

While the reasons for these differences are not clear, one likely factor is that the responses from graduates relate to the importance of these skills to them in terms of their career progression while the responses from the employers relate to the importance of the skills to their organisation.

Graduates would most likely look at technical engineering skills as a prerequisite for getting a job and that skills such as critical/analytical thinking, oral communication and teamwork are important for their career progression. Employers would expect graduates to be knowledgeable in their engineering discipline and to be able to communicate effectively when they are hired into their first job.

4.4 Effectiveness of education

Overall graduate respondents found that their education at the Institutes was effective in preparing them with respect to the skills listed above. Figure 21 shows how well the graduate respondents felt their education at their Institute helped them to attain these skills which are listed in order of importance from Figure 18 above.

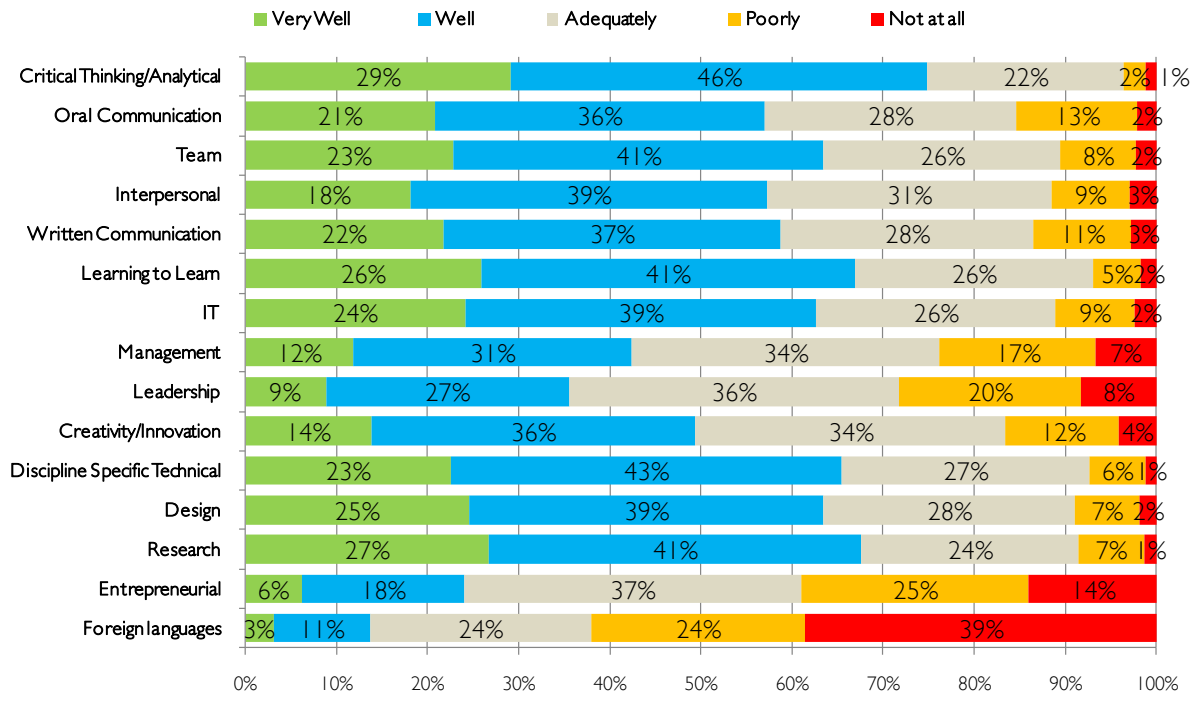


Figure 21: Graduates' views on the effectiveness of their education in helping them attain skills

This chart shows that 75% of graduate respondents felt they were either "very well" or "well" prepared in terms of critical thinking/analytical skills and 66% felt similarly about discipline specific technical skills. However, only 59% and 57% of graduates felt as prepared in terms of their written and oral communication skills, respectively.

When the graduates' views on the importance of skills to their career are compared to the effectiveness of their education, it shows that preparation in the areas of team skills, oral and written communication skills and interpersonal skills are at a level below the importance of those skills to the graduates (Figure 22).

Figure 22 compares the graduates' views on the importance of key skills and the effectiveness of education in these skills. Importance is based on the percentage of graduates who indicated the skill was "essential". Effectiveness is based on the percentage of graduates who indicated their education prepared them "very well" or "well".

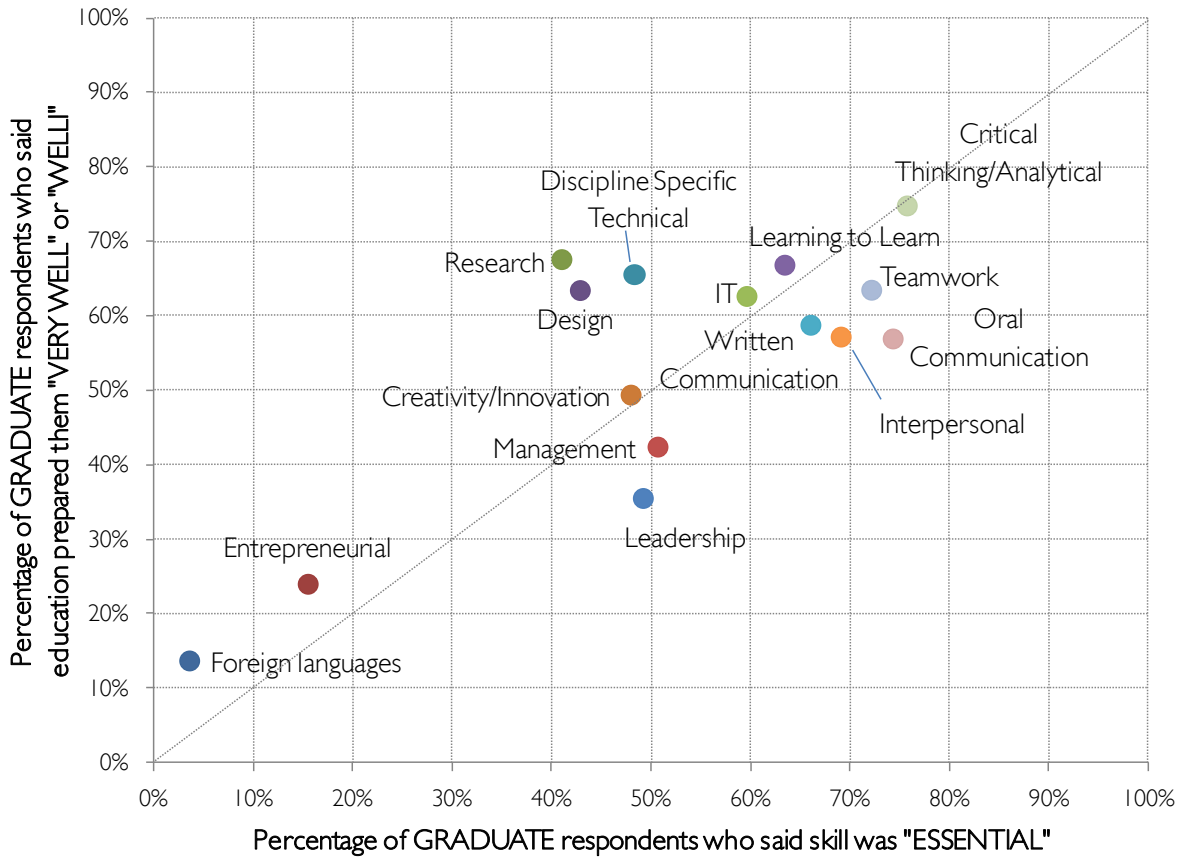


Figure 22: Comparison of importance of skills and effectiveness of education for graduates

Those skills that are above the diagonal line such as discipline specific technical skills were rated higher in terms of education preparation relative to the importance of the skill to the graduate. Those skills below the diagonal line such as oral communication and interpersonal skills were rated higher in terms of importance to the graduate relative to the preparation provided by their education. These skills indicate areas where the graduates feel their education at the Institutes might be improved.

Graduates across all of the focus groups noted the importance of oral and written communication skills and said that on reflection they could have done with more support in these areas during their education. For the majority of graduates, they noted that communication skills tended to be covered in the final year of their programme. Many felt that it would be better to include such modules in all years of the programme.

Anecdotally, one graduate noted that engineers who succeed are those who develop the non-technical skills that enable them to communicate effectively in the work place. Engineering programmes focus more on technical aspects which leaves graduates unprepared for a real world work environment where people constantly work in teams and must have good communication skills.

Some graduates noted that it would be helpful to be required to submit their student assignments to lecturers in a format that is expected or required by potential employers. Significant assignments should be submitted in report form and minor assignments in e-mails or letters as appropriate. This would allow students to become familiar with the written communication standards that they will be required to meet once they start working.

4.5 Employer satisfaction

A similar analysis of the employers' satisfaction with the NFQ Level 8 engineering graduates' attainment of these skills and the importance of these skills to employers again identified certain deficiencies.

The respondents to the employer survey were asked to indicate their level of satisfaction with engineering graduates' possession of the skills using the following four ratings – very satisfied, satisfied, somewhat satisfied and not at all satisfied.

Figure 23 shows employer satisfaction with all graduates for the skills ranked in order of importance from Figure 19 above. Employers were most satisfied with the graduates' attainment of technical engineering skills with 81% of respondents indicating that they were "satisfied" or "very satisfied" with graduates in this area, while the satisfaction level for written communication was only 50%.

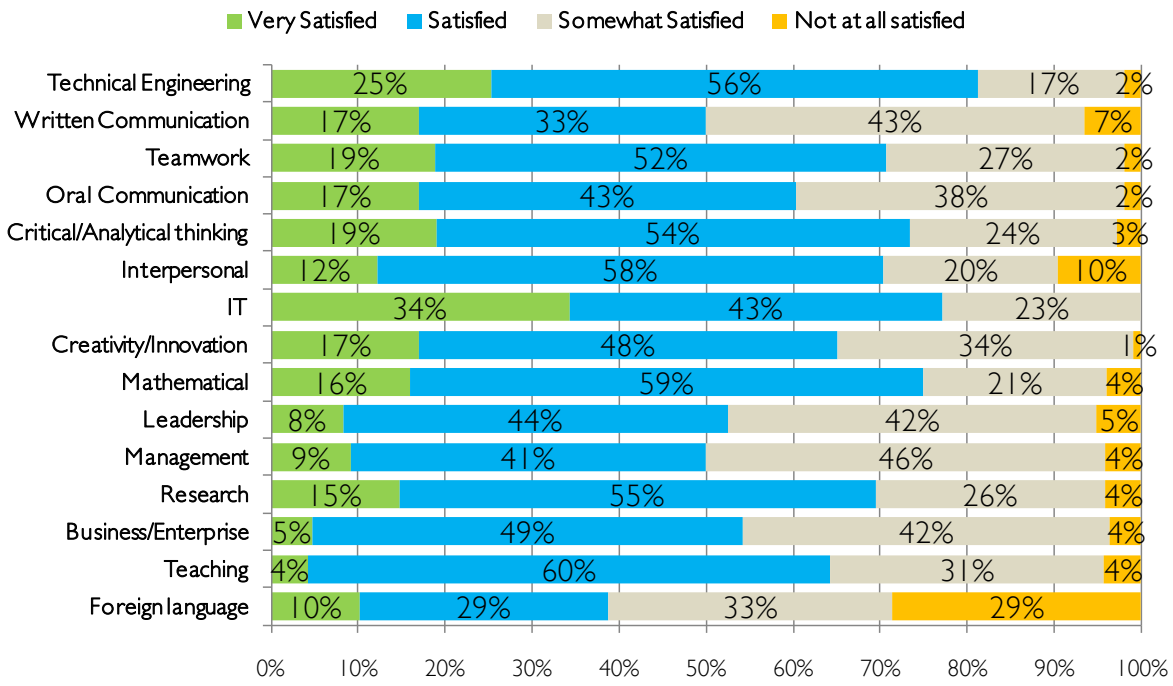


Figure 23: Employer satisfaction with graduates' attainment of skills

Figure 24 compares the importance of the skill to employers versus their degree of satisfaction with institute of technology graduates' possession of those skills. Importance is based on the percentage of respondents who indicated the skill was "essential" and satisfaction is based on the percentage of respondents who indicated they were "very satisfied" or "satisfied" with the graduates' attainment of the skill.

The skills above the diagonal in Figure 24 such as "Mathematical" and "IT" suggest that employers are satisfied with all graduates' preparation in those skills relative to their importance. However, those skills below the diagonal such as written and oral communications, teamwork and interpersonal skills show areas where employers feel that the graduates' education might be improved.

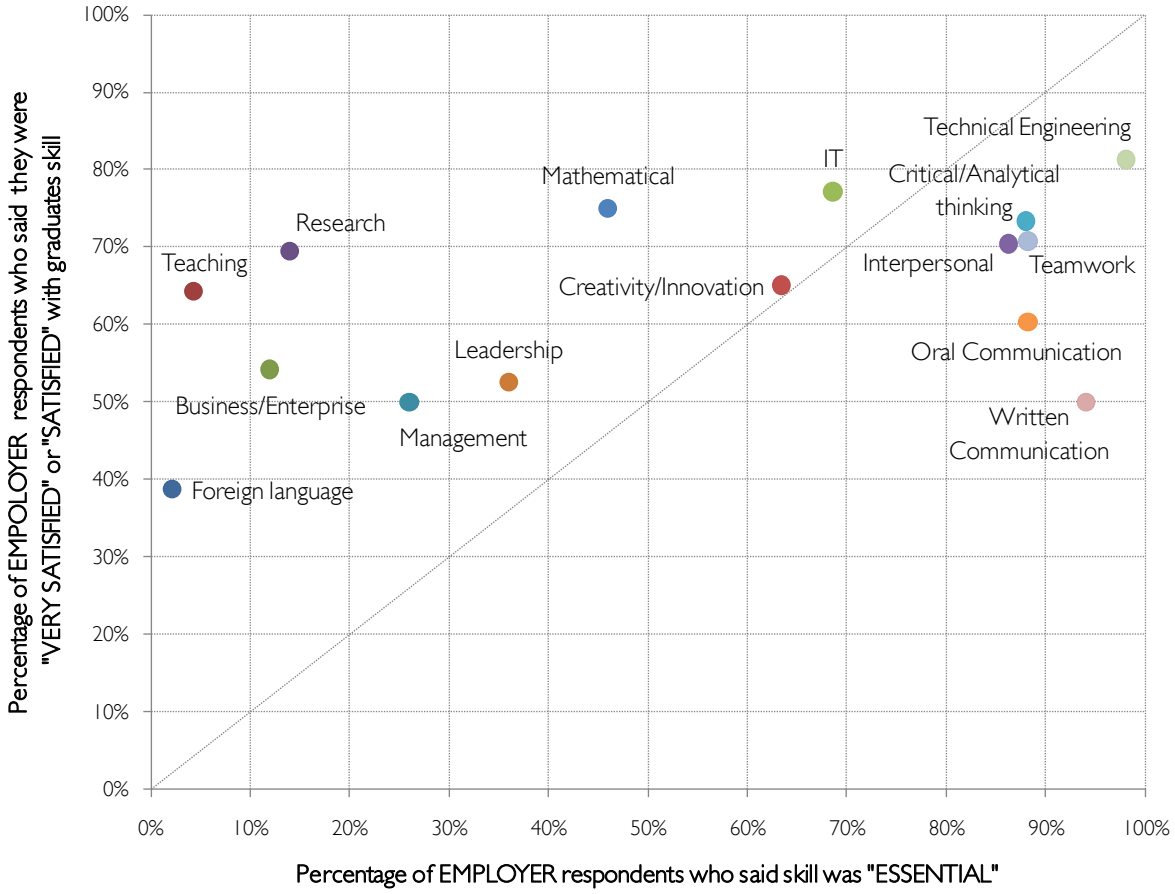


Figure 24: Comparison of employers views on the importance of skills and satisfaction with graduates

4.6 Initial graduate training

Information about the subjects for which training is provided by employers during a graduate's first year with an organisation might indicate areas where a graduate's education might be enhanced. The upper bar in Figure 25 from the employer survey shows that more than 4 out of 5 of the respondent organisations provide training for NFQ Level 8 engineering graduates during their first year. The chart also includes the breakdown by size of organisation which shows that higher percentages of larger organisations provide this training.

In the graduate focus groups, participants noted that most graduates underwent formal training programmes, ranging in duration from a few weeks to 6 months. Engineers working in large companies participate in long term graduate programs which can last up to 2 or 3 years.

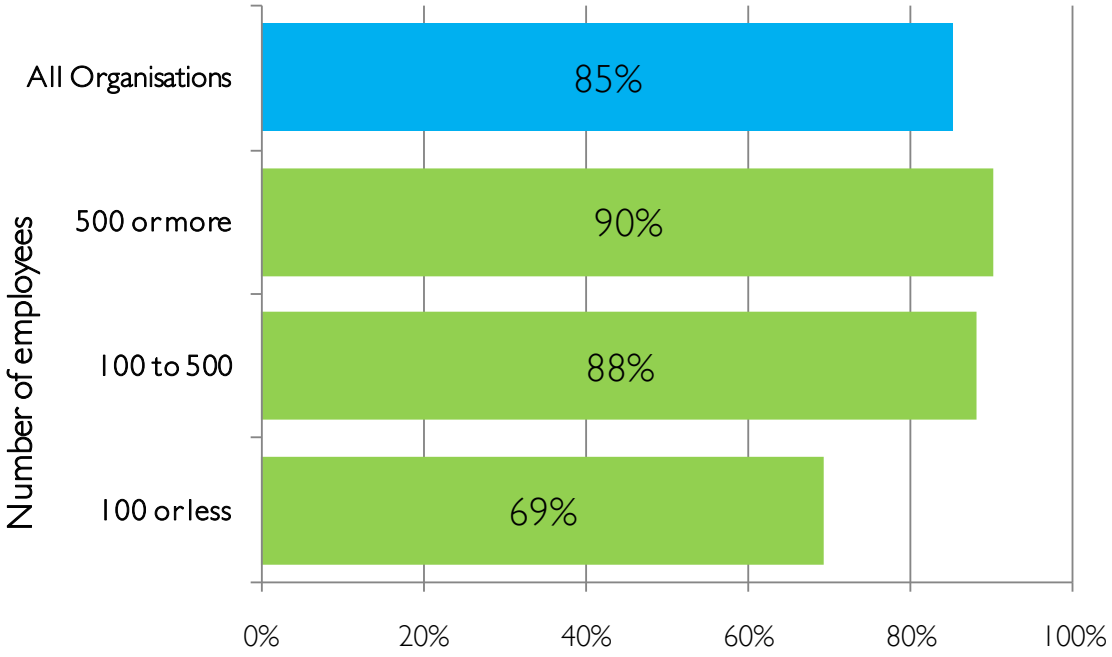


Figure 25: Percentage of organisations providing training to NFQ Level 8 graduates

Figure 26 below shows the range of areas in which training is provided to the graduates as well as the number of training days provided in the first year. It shows that almost all of the respondent organisations that provide training do so in the area of technical engineering and that 9 out of 10 of them provide practical engineering training.

Figure 26 also shows that between 6 and 7 out of every 10 respondent organisations that provides training do so in the areas of oral and written communication and in teamwork. This appears to reinforce the views of both the graduate and the employer respondents as outlined in the previous sections that the non-technical skills of engineering graduates could be enhanced.

The graduate focus group participants indicated that the training provided by employers consisted mainly of practical skills such as:

- use of employer specific equipment or computer applications;
- details on the design and operation of employer's products; and
- health and safety in the workplace.

In each of the nine focus groups, at least one graduate had been given a training course in non-technical or generic skills. In larger companies these courses were provided internally by the company and covered Microsoft packages such as Excel and PowerPoint, presentation skills and report writing. Some graduates attended report writing courses provided by Engineers Ireland.

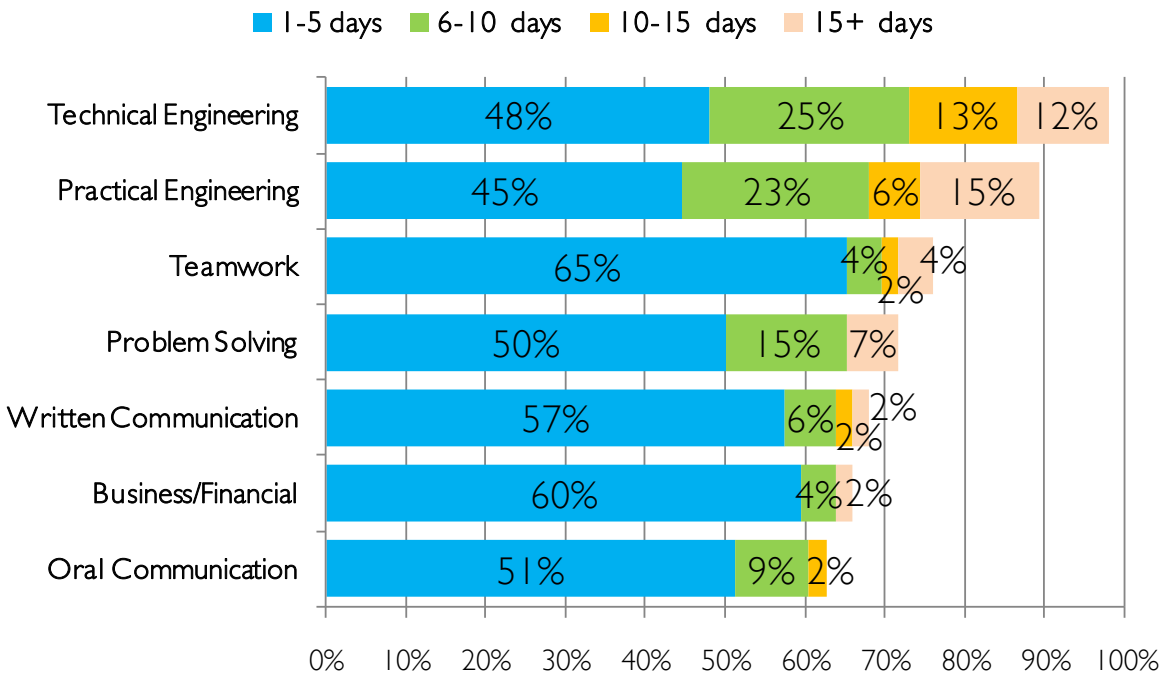


Figure 26: Skill Areas for which training is provided by employers

4.7 Perceptions of institute of technology qualification

The graduate survey asked graduates of the Institutes how they felt their qualification was perceived by their employers, their peers and the general public, as compared with a similar qualification from a university. The research shows that graduates believe that their qualification is well recognised by employers and work colleagues but less so by the general public.

The upper bar in Figure 27 shows that 68% of graduates view their own qualification to be equally recognised relative to university qualifications. The lower two bars show that 65% and 62% of graduates believe that their work colleagues and employers also perceive the graduates' qualifications to be equally recognised, respectively.

However, the second bar from the top shows that less than half of the graduates believe that the general public perceives their engineering qualification as of equal value to university qualifications.

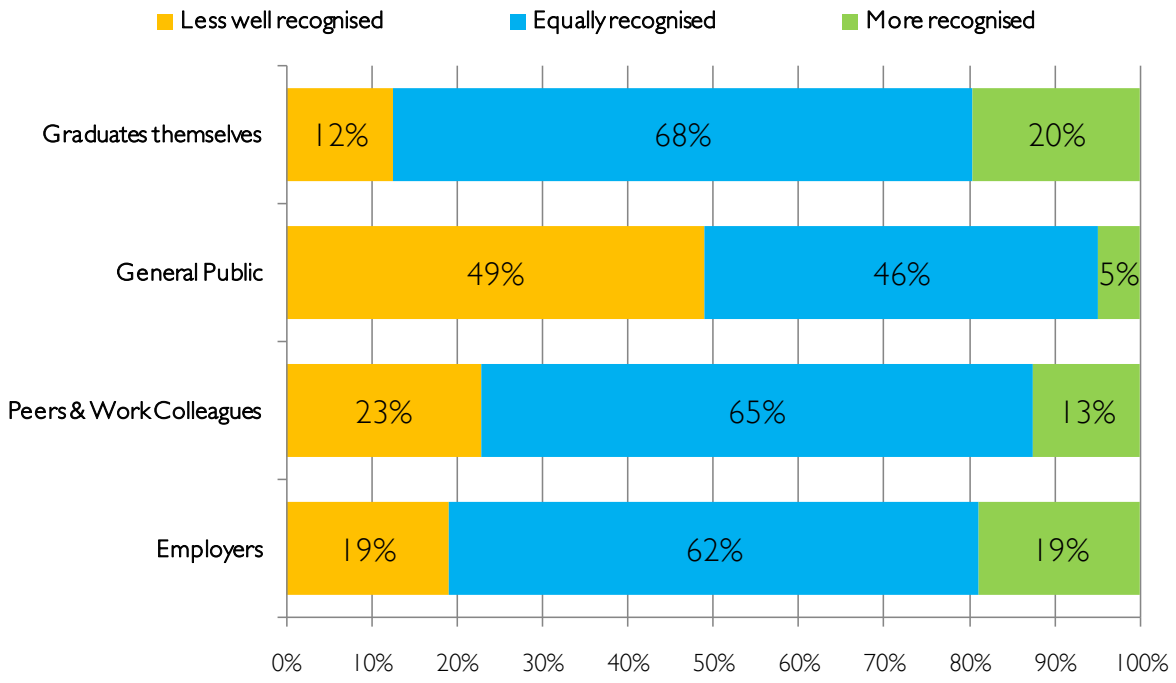


Figure 27: Views of Graduates on recognition of their qualifications by various groups

Figure 28 takes the graduates' views on their employer's perception (the lower bar above) and breaks it out by engineering discipline. In computer/software disciplines, 27% of the Institutes' graduate respondents felt their employers did not perceive their NFQ Level 8 qualification to be equal to a similar university qualification while 29% of civil engineering and 26% of chemical graduate respondents felt their employers perceived their qualifications to be more recognised.

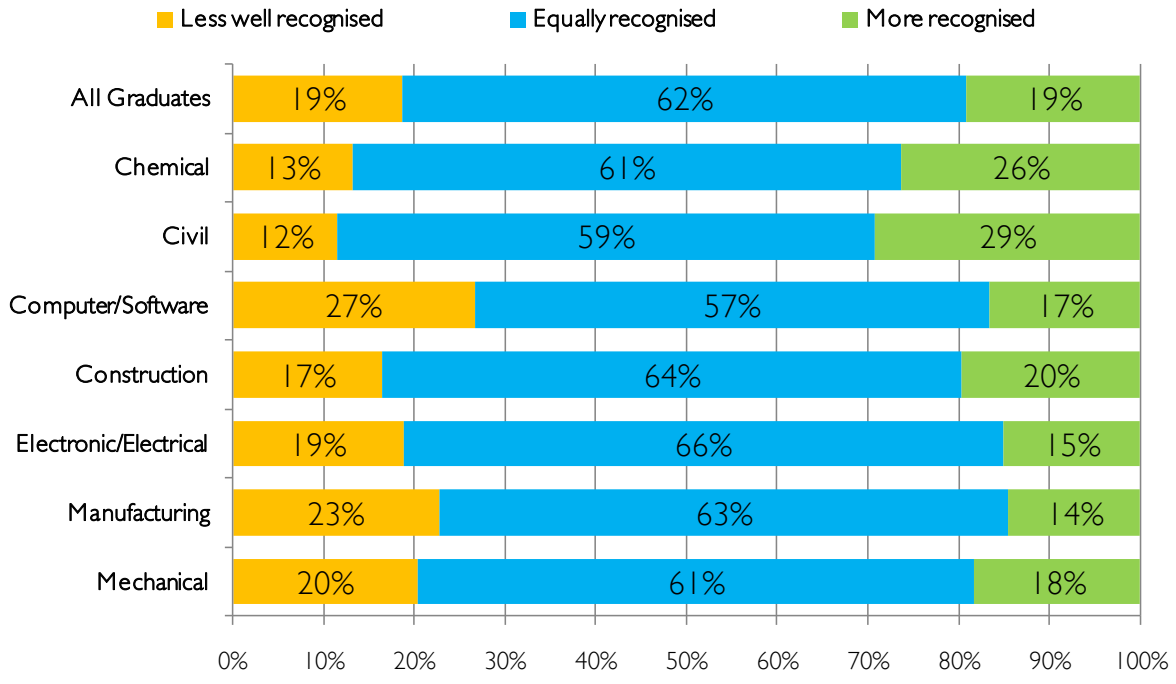


Figure 28: Graduates' views on their employers' perceptions of their qualification - by discipline

Figure 29 shows the same data on the graduates' views of their employer's perception of their qualification (again the lower bar in Figure 27) but now split by Institute.

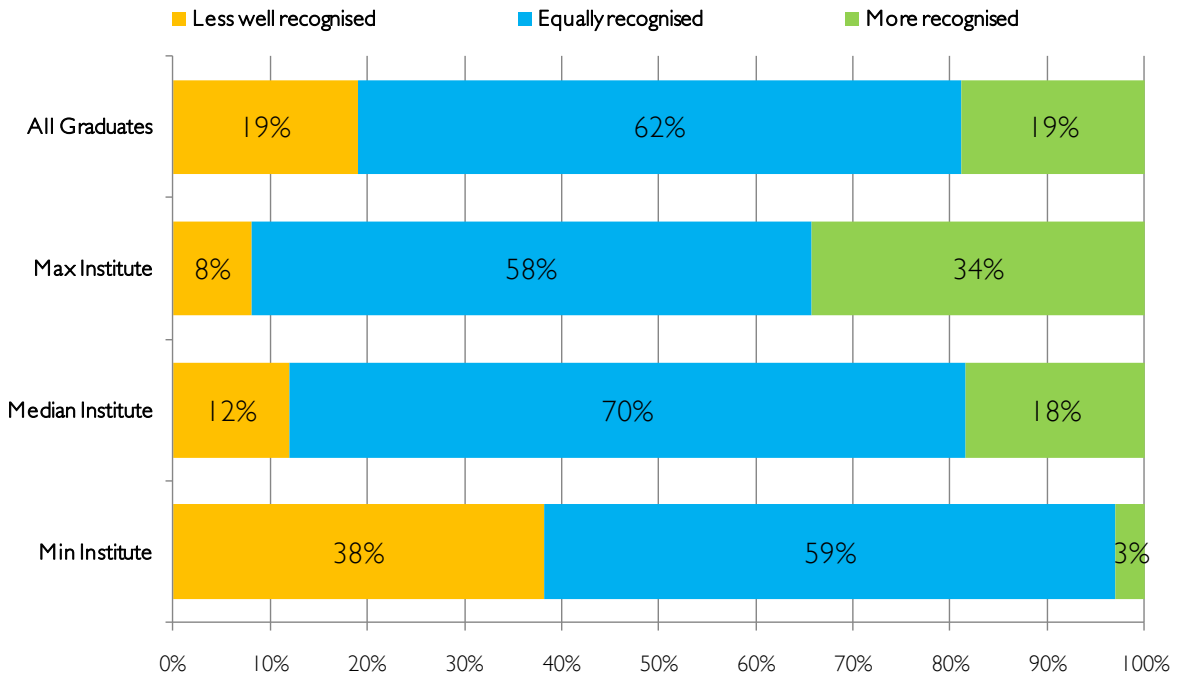


Figure 29: Graduates views on their employers' perceptions of their qualification - by Institute

While there is wide variation across the Institutes, as stated earlier in this report, a number of underlying factors contribute to these differences. These include the differences in the disciplines represented across the Institutes, the number of years the graduates have been working and the number of graduate respondents from each Institute.

4.8 Graduate recommendations

The focus groups found that, all things considered, graduates were happy with engineering as a career, although a very small number were disappointed with their compensation. Graduates who are not now working as engineers were disappointed that suitable engineering jobs were not available when they graduated. They would have preferred engineering as a career instead of their current job.

The vast majority of the graduates in the focus groups would recommend engineering as a career. However, one or two participants in each focus group were reticent given the lack of jobs in the current economic climate and they strongly suggested that prospective students consider the sectors most likely to provide future opportunities for engineers.

More than 8 out of 10 institute of technology graduates are very happy to recommend their programme and 9 out of 10 graduates are happy to recommend their Institute.

Figure 30 shows that 82% of all graduates who completed the survey tended to agree with the statement that "*I would recommend the programme I took to others*". The chart also shows the breakdown by engineering discipline, ranging from 86% for civil engineering at the highest to 78% for computer/software graduates at the lowest.

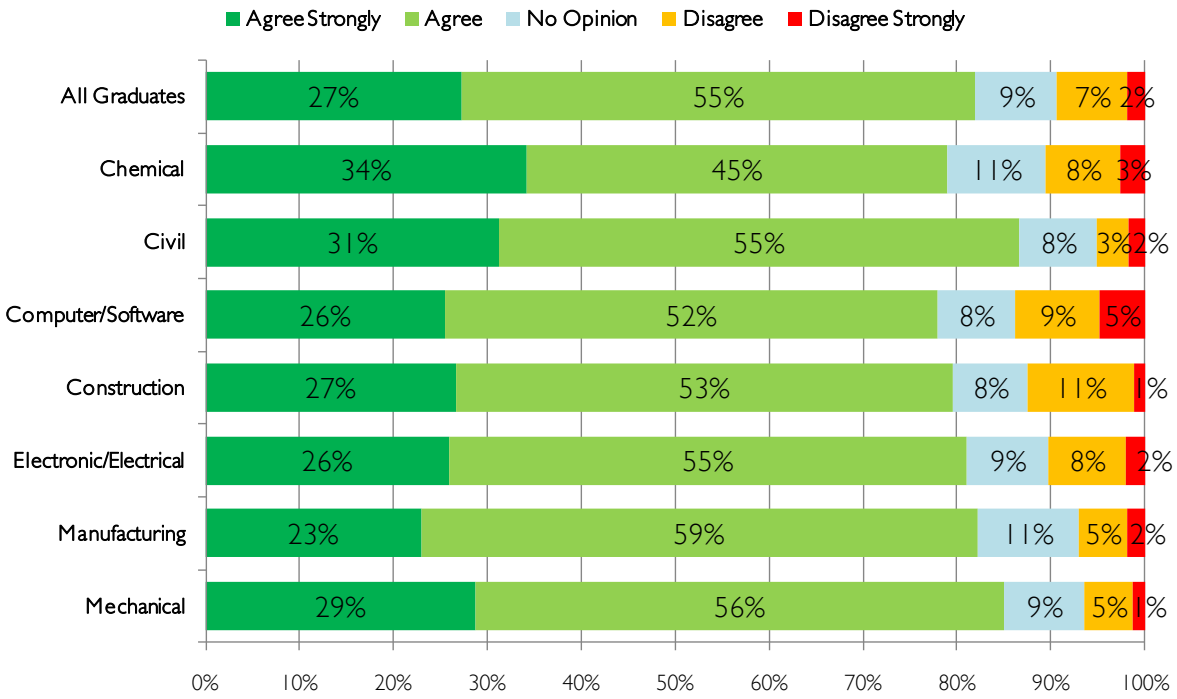


Figure 30: Graduates' agreement by discipline with statement "I would recommend the programme I took to others"

Figure 31 shows that 90% of graduates agreed with the statement that "*I would recommend my Institute to others*" and this ranges from 84% for chemical and civil engineering graduates to 93% for graduates of electronic/electrical engineering programmes.

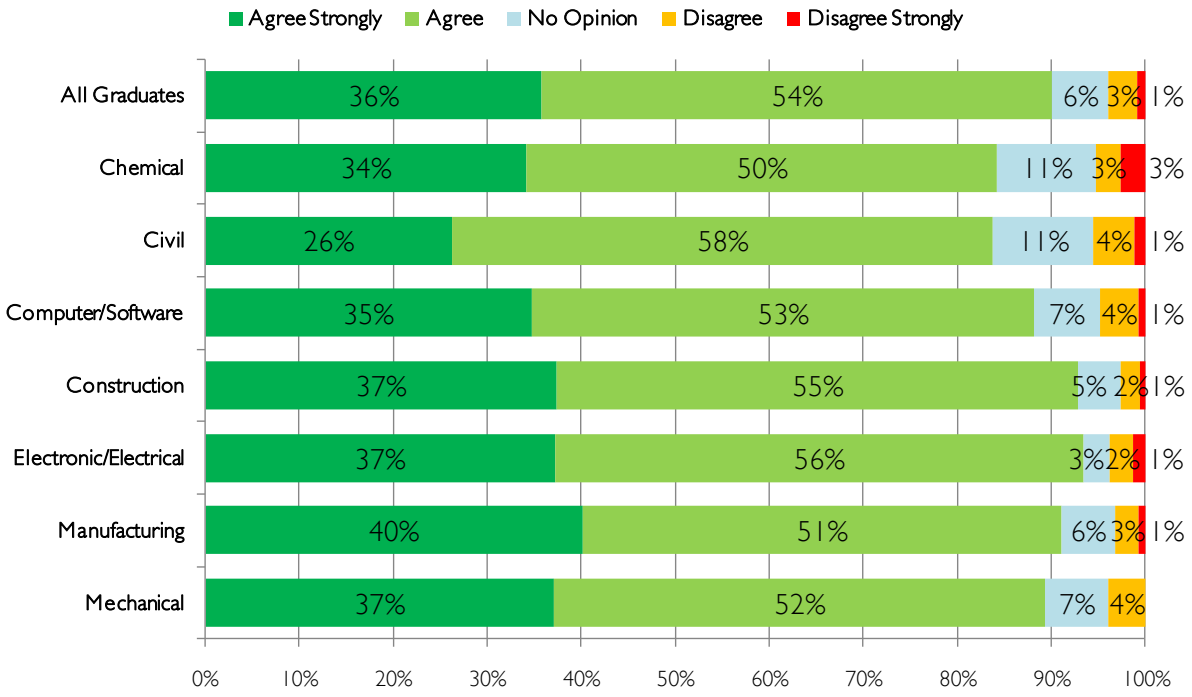


Figure 31: Graduates' agreement by discipline with statement "I would recommend my Institute to others"

Figure 32 shows the variation by Institute for graduates agreeing that they would recommend their Institute with the lowest level of agreement at 85%.

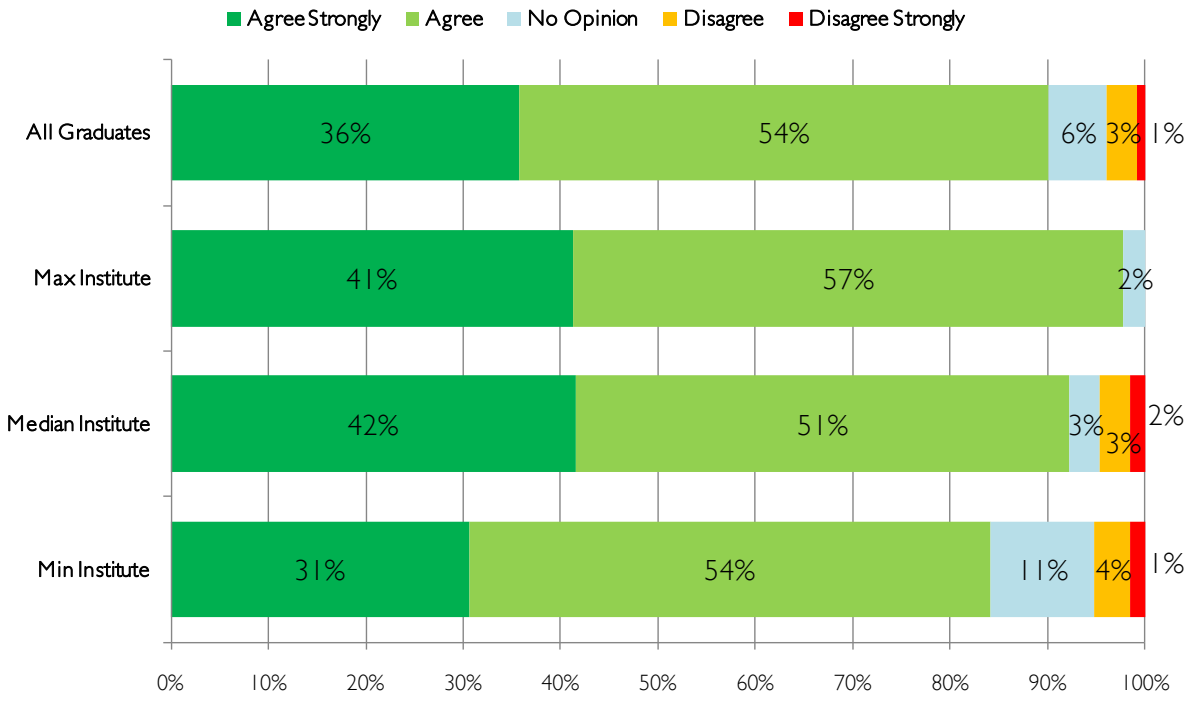


Figure 32: Graduates' agreement by Institute with statement "I would recommend my Institute to others"

The vast majority of graduates in the focus groups would recommend studying engineering at an institute of technology and all would advise prospective students to assess the syllabi of the various engineering programmes being considered.

The participants in the focus groups offered a number of reasons for their recommendation to study at an Institute of Technology which were anecdotally based and may not necessarily be accurate. These included:

- They felt the Institutes have smaller class sizes;
- Institute lecturers are perceived to be more approachable and available;
- University students seem to have less interaction with lecturers;
- Participants felt that institute of technology students get more practical experience and as a result might be considered to be more practical by employers;
- Institute of technology students also benefit from a workload that is perceived to be more intense; and
- The institute of technology ladder system of Level 6, 7 & 8 programmes gives students flexibility to study, get work experience in industry and then return to further study.

Where graduates did not recommend the Institutes of Technology, they offered the following anecdotally based views:

- They felt that Institutes of Technology have poorer facilities compared to Universities;
- Universities seem to be able to provide better supports to the students as they search for a job; and
- Some university programmes allow students to specialise early and also give students more flexibility in selecting engineering modules.

4.9 Employers' views of higher education institutions

As part of the employer survey, respondents were asked about their organisation's relationship with the Institutes relative to the Universities and about the types of projects which they had completed with the higher education institutions. The survey also explored how the respondents viewed the positioning of the higher education institutions in terms of developments in technology.

4.9.1 Relationship with higher education institutions

Almost half of the organisations surveyed rated their overall relationship with the Institutes to be "as close" as those with the Universities, with the remainder almost equally split between "not as close" and "closer" as shown in Figure 33.

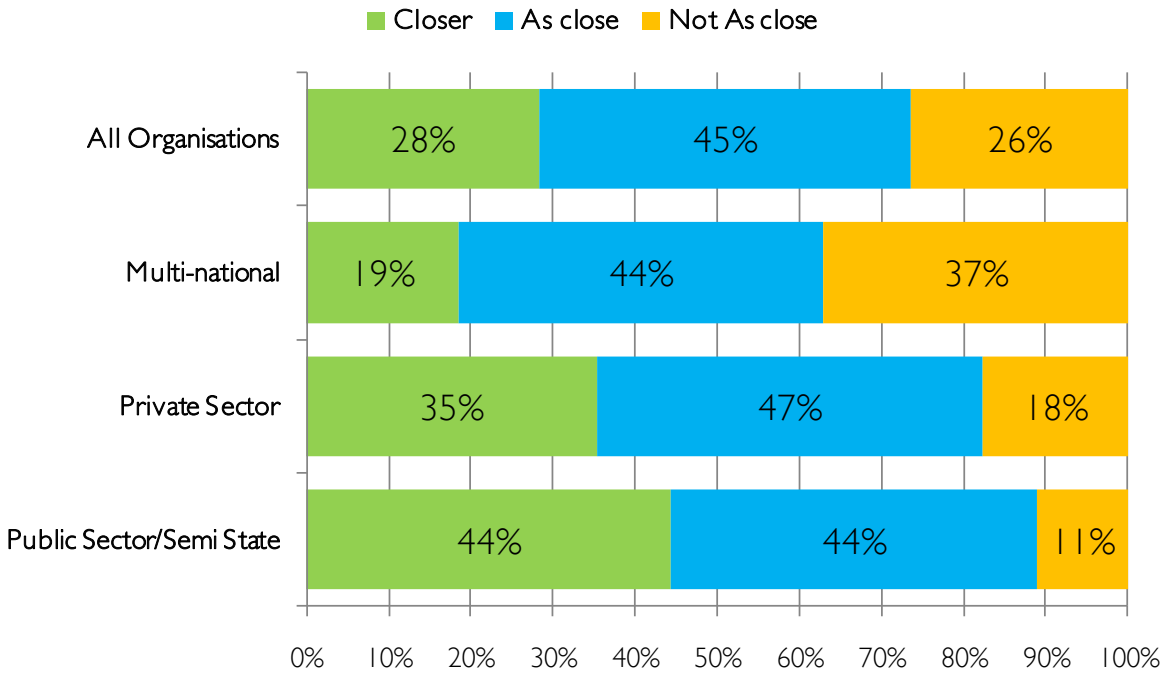


Figure 33: Employer views on relationship with Institutes of Technology relative to Universities

The chart also shows that a higher proportion of indigenous private sector organisations (35%) have a closer relationship with the Institutes of Technology compared to only 19% for multi-national organisations.

4.9.2 Project activities with higher education

Employer respondents were asked if their organisation had completed a project with the higher education institutions in any of the following areas - training, basic or applied research or product/process development. Figure 34 shows the percentage of organisations that have completed a training, research or product/process development project with an engineering school or faculty.

Similar percentages of respondents noted that their organisations have completed projects with the Institutes and the Universities for basic and applied research. However, more organisations engage with the Institutes for training projects while a slightly higher percentage engage with the Universities for product/process development projects.

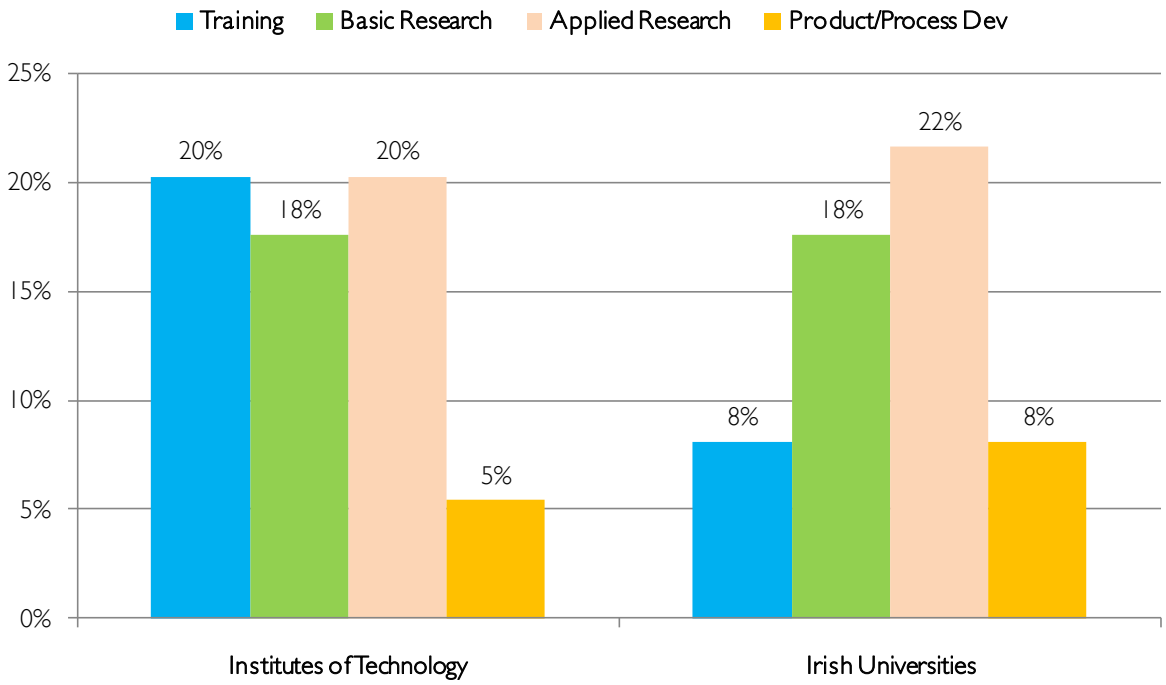


Figure 34: Percentage of organisations completing projects with institutions

4.9.3 Technology developments

Almost 7 out of 10 survey respondents found that the Institutes of Technology were sometimes at the leading edge in terms of being "up to speed" on developments in technology and as places to seek assistance in exploiting those technologies.

Figure 35 below shows the percentage of employer survey respondents who felt the various higher education institutions were either generally behind the leading edge, sometimes at the leading edge or always at the leading edge of technology developments.

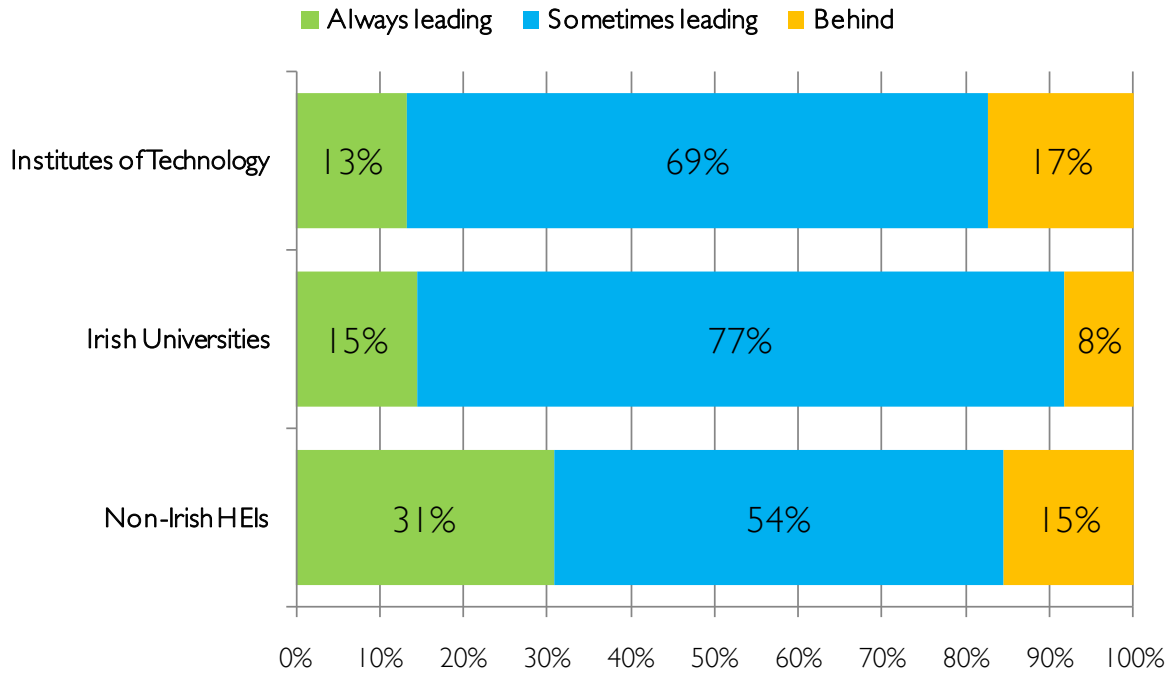


Figure 35: Employer views on institutions with respect to technologies

4.10 Suggestions and recommendations for the Institutes

The surveys and focus groups gathered many suggestions on how engineering education at the Institutes might be enhanced. Some of the more frequently mentioned by the graduate and employer respondents and participants included the following which are described in more detail below:

- More work placement opportunities;
- Better career guidance and preparation for interviews;
- Mathematics taught in an applications context;
- More education about what it is to be an engineer; and
- Closer links between Institutes and the organisations that employ their graduates.

4.10.1 More work placement opportunities

Both the graduate and employer respondents were consistent in their suggestions that the Institutes should provide more work placement opportunities for their engineering students during their education.

Many graduates pointed to the value of the experience they gained through their work placements. These placements helped them to learn specific practical skills and to see the theory taught in the classroom as practiced in the workplace. One of the common themes that emerged from the focus groups of graduates who felt inadequately prepared for their first job

was that there was no work placement as part of the programme and potential employers were looking for work experience when hiring.

The knowledge and experience gained through work placement was in turn very much valued by employers who factored a graduate's work placement experience into their hiring decision. In the employer focus groups, participants noted that the practical skills of institute of technology graduates are slightly ahead of university graduates at the outset of their career so that they tend to hit the ground running. This was often credited to the applied nature of the institute of technology programmes and the experience graduates gain through work placement opportunities.

The employers suggested that the Institutes should be more proactive in approaching businesses to identify work experience opportunities for their students. They also suggested that the Institutes develop and maintain a database of their students who might be available for short term work placements so that it is easy for organisations to find such students when needed.

4.10.2 Better career guidance

A common theme with graduates who felt inadequately prepared for their first job was that their Institute did not provide enough career guidance or enough support to the graduate as they searched for that first job. Many of these graduates noted that they did not feel prepared for the interview process.

Many employers contacted in the research noted that graduates of all higher education institutions have poor written communication skills, with many unable to effectively structure a business email or a written report. In the employer focus groups, participants noted that the CVs of many graduates are badly written and contain poor English such as phone text abbreviations. This creates a poor impression and does not do the graduates justice. Furthermore, there were frequent anecdotes of graduates presenting for interview with a limited knowledge about the activities of the company to which they had applied for a job.

The graduates and the employers both suggested that the Institutes should provide more support to students in their job seeking activities. This could include providing information about prospective employers, guiding students in the development of their CVs and preparing for interviews.

4.10.3 Mathematics taught in an applications context

During the graduate focus groups, it emerged that many graduates would have liked more practical applications of mathematics as part of their programmes and would also have

preferred that mathematics be taught by engineers. These practical applications of mathematics would focus on the situations in the engineering workplace where mathematical principles are used, why these principles are helpful and how they are applied. These graduates would like to change the way mathematics is taught in their programmes so that students do not spend their time learning how to pass an exam but instead learn and understand how mathematics is of essential value to engineers in the workplace.

4.10.4 What it means to be an engineer

Graduates in most of the focus groups noted that they would have liked to have learned more about what it is to be an engineer in a working environment. Many commented on the difficulties they faced as an engineer in their first job including thinking and making decisions like an engineer and how the engineer's role fits into the overall company structure. A few graduates noted that their engineering education was too technically focused and that they entered industry without having any real knowledge of how a business works.

In the employer focus groups, participants noted that it is common for graduates to have a limited understanding of the *raison d'être* of the organisation they have joined, e.g. the commercial realities of projects in construction or engineering consultancy or the political realities of the public sector.

Graduates also have a poor understanding of the structure and value chain of their industry and how the company they work for fits into that value chain.

Finally, the employers noted that graduates have a limited understanding of what it means to be an engineer in a company and are often unaware of how their work impacts on the costs of their employer and how that translates into value for their customer.

Many graduates recommended that the Institutes should bring in engineers from industry to talk with students and to describe engineering problems and solutions from their work environment. This would give students exposure to the inner workings of organisations and help with their understanding of the practical application of engineering theory.

4.10.5 Closer links with external organisations

Many of the employers surveyed noted that the Institutes could develop closer links with industry by having working engineers come into class to talk about their day-to-day work as an engineer in industry and by bringing students onto site visits with companies. This will give engineering students a richer understanding of the realities of the workplaces in which they are likely to work.

The employers also encouraged lecturers to have more regular interactions with industry so that they are exposed to the current issues that are relevant in Irish companies. This will allow lecturers to pass on valuable information to students about the modern practicalities of Irish industry. They also suggested that the Institutes hire engineers with recent practical experience as lecturers so that they can bring workplace experience into the classroom.

4.11 Topics meriting further exploration

A number of interesting topics emerged from the surveys and focus groups which were outside the scope of the research study, including:

- the public's perception of the institute of technology qualification;
- the value of engineering academic staff engaging in work experience; and
- the views of employers about the performance of engineering graduates of non-Irish higher education institutions.

4.11.1 Public's perception of the institute of technology qualification

Many of the institute of technology graduates believe that the general public has a relatively poor perception of their qualification – see section 4.7 on page 44. This perception is not shared by either the graduates' peers or their employers who have a more informed perspective on the quality of the NFQ Level 8 graduates from the Institutes.

As this is just the opinion of the graduates, a study of the views of the general public about the Institutes and their graduates may be helpful to better understand the realities of the situation. If such a study did confirm that the general public held this view, this would suggest the need to consider investing in some marketing initiatives to enhance the public image of the Institutes.

4.11.2 Value of work experience for academic staff

While many of the graduates and employers commented about the value of work placements for students during their engineering education, one or two of the participants in the employer focus groups wondered about the value of lecturers spending time in industry. This might see lecturers working with an organisation for a number of weeks every year and participating on an engineering project in their field. Alternatively lecturers might take regular sabbatical breaks every 3 or 4 years to spend a number of months with an organisation when they would take complete responsibility for an engineering project.

Such regular and close interactions with industry would appear to have many benefits that would accrue to the engineering students. These include helping the academic staff to stay current with the issues that organisations face and providing lecturers with recent experience of

engineering situations that can be brought to life in the classroom. These interactions would enhance the links between Institutes and industry and would lead to increased opportunities for student work placement.

While there appear to be benefits that would follow from work experience for academic staff, further exploration would be required to fully understand the practicalities of such an initiative and the levels of interest amongst academic staff and potential host organisations.

4.11.3 Performance of engineering graduates of non-Irish HEIs

Investigating the performance of engineering graduates of non-Irish higher education institutions was not a primary objective of the study and the sampling methodology did not target organisations that hired such graduates. The survey also did not profile the graduates of non-Irish HEIs to determine if they were working in their first job since graduating or how their qualification compared to a NFQ Level 8 engineering degree.

However, the employer survey respondents were invited to indicate some views about the graduates of non-Irish HEIs. Figure 36 shows the respondents' views on the preparation of these graduates. There is some similarity with the employers' views on the preparation of institute of technology graduates as shown in Figure 9 above on page 27.

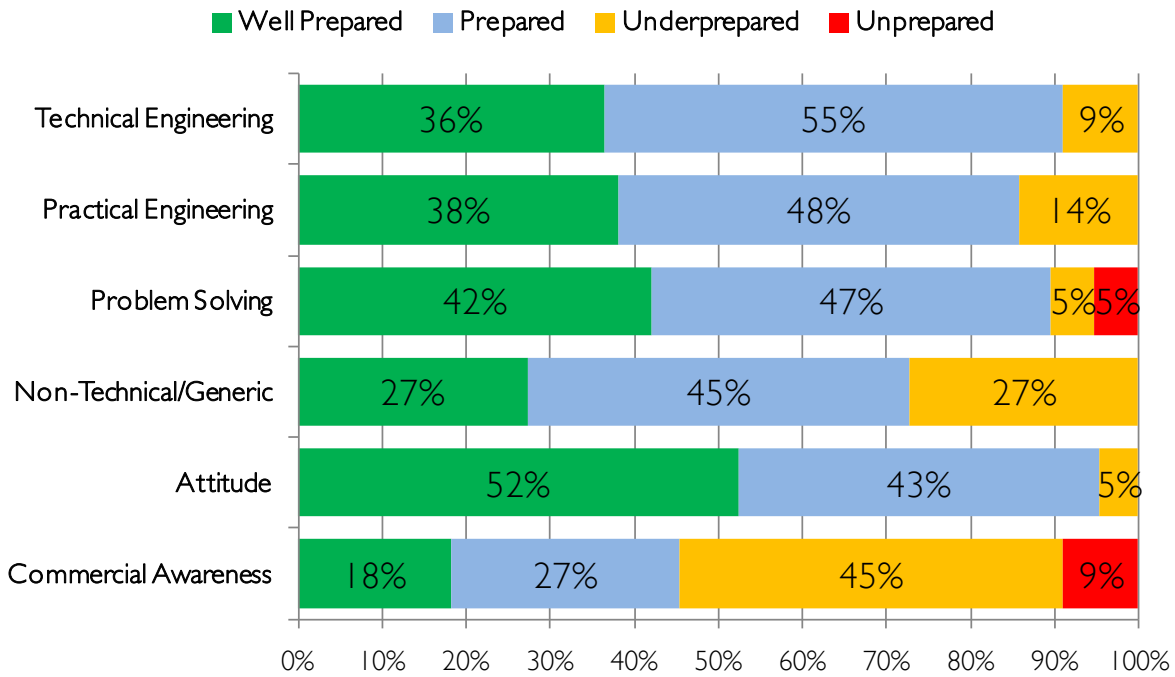


Figure 36: Employers' views of preparation of graduates of non-Irish HEIs

The graduates of non-Irish HEIs are regarded as being relatively well prepared in terms of technical and practical engineering skills, problem solving skills and also appear to have a good attitude. Like graduates of Irish HEIs there is room for improvement in terms of the non-technical/generic skills such as oral and written communication and in the graduates' commercial awareness.

The number of respondents to this question is statistically low with just over 20 employers commenting on the preparation of non-Irish HEI graduates. Therefore, no conclusions can be drawn from the responses. A detailed and targeted study is required to better profile such graduates working in Ireland and the views of their employers.

5 Conclusions & Implications

The research study, has primarily explored how NFQ Level 8 engineering graduates from Institutes of Technology over the period 2000 to 2008 were prepared for their first job and how these graduates have progressed in their careers.

The graduate survey and graduate focus groups along with the employer survey and employer focus groups have gathered useful information which will inform the decisions by the academic staff of the engineering schools in the Institutes to enhance the education they offer.

The research study has also created a baseline data-set on NFQ Level 8 engineering graduates from the Institutes which will be used as a reference point in future studies. This will enable the Institutes to continue to assess the progress of their graduates and to also evaluate the future enhancements to their engineering programmes.

Conclusions - Graduate preparation

The research study has found that institute of technology NFQ Level 8 engineering graduates believe their education prepared them adequately for their first job and their career. Graduates have been generally prepared or well prepared in terms of technical and practical engineering skills. However, their preparation in terms of key non-technical skills such as oral and written communication needs improvement.

Many graduate respondents would like their education to have included more information about what it is to be an engineer and examples of the practical problems that engineers deal with on a day-to-day basis. Graduate respondents would also welcome more work placement opportunities and career guidance support as they seek their first job.

Employer respondents have found the institute of technology graduates they have hired to be prepared or well prepared in terms of their technical and practical engineering skills and to also have a positive attitude to their work. However, the employers felt that the graduates' preparation in terms of communication skills should be improved. Furthermore, these employers noted that the graduates lacked a commercial awareness and did not understand how their role as an engineer contributed to the organisation.

Employer respondents also found the preparation of institute of technology NFQ Level 8 engineering graduates they hire to be as good as that of other graduates they hire. While some differences in practical and communication skills might be noticeable when graduates start work, these differences quickly disappear.

CONCLUSIONS - GRADUATE PROGRESSION

The majority of institute of technology NFQ Level 8 engineering graduates feel that their career is progressing as they expected and that they are being given the roles and responsibilities appropriate to a NFQ Level 8 graduate. They also feel that they are being given the same opportunities as graduates of other higher education institutions and that progression is a function of a graduate's skills and ability rather than where they were educated.

The employers noted that the majority of institute of technology graduates are either meeting or exceeding expectations and that these graduates are progressing well within their organisations. Employers also found that the majority of institute of technology graduates they have hired are progressing at a similar rate to other NFQ Level 8 graduates.

IMPLICATIONS

The findings of the research study will have a number of implications for engineering education offered across the Institutes, two of which overlap with the recommendations of the National Strategy for Higher Education (NSHE)[12] as outlined below.

TEACHING OF NON-TECHNICAL SKILLS

The teaching of key non-technical skills such as oral and written communication will need to be enhanced and integrated into the earlier years of the engineering programmes. This will help "prepare first year students better for their learning experience" as suggested in the NSHE (*Recommendation #5, p15*) and provide them with the communication skills to be better prepared for their first job and a fulfilling career. Where appropriate, the Institutes should consider making industry standard reports and formats an integral part of the submission requirements for student projects.

CLOSER LINKS WITH INDUSTRY

The Institutes should build closer links with industry that will bring multiple benefits to the students and academic staff. These links could include working engineers presenting to engineering students about the engineering tools and skills they are using in their projects, more site visits for students to see how engineering is practiced within organisations and possibly work experience opportunities for academic staff.

These links will lead to additional opportunities for work placement which will further benefit the education and job prospects for the students. The links will also provide the students with a better understanding of what it is to be an engineer in the modern workplace.

[12] *National Strategy for Higher Education*, Report of the Strategy Group, January 2011

These closer links will also address the following NSHE recommendations:

- *Teaching and Learning recommendations #3 and #8, pp 14 &15*
    - Every student should learn in an environment that is informed by research, scholarship and up-to-date practice and knowledge.
    - All higher education institutions must ensure that all teaching staff are both qualified and competent in teaching and learning, and should support ongoing development and improvement of their skills.

- *Engagement with the wider society recommendation #14, p 18*
    - Engagement with the wider community must become more firmly embedded in the mission of higher education institutions. To achieve this, higher education institutions will need to … encourage greater inward and outward mobility of staff and students between higher education institutions, business, industry, the professions and wider community.

Other implications of this research study such as how mathematics is taught; the level of career guidance provided to students; and the relationships with multi-national organisations will also need to be considered by the heads of the engineering schools as they re-design their programmes for future engineering students.

6 INSTITUTE OF TECHNOLOGY RESPONSE

The National Strategy for Higher Education underlines the importance of innovation and enterprise and well qualified engineers are central to furthering that strategy. This NFQ Level 8 engineering graduate study represents an intense dialogue between engineering faculties across all the Institutes to gain insight into the quality of our engineering education.

The study, commissioned by the Institutes with support from HETAC, provides a fresh insight into how honours bachelor degree engineering graduates from the Institutes are perceived by employers, how well the graduates themselves feel they are prepared to perform as engineers, and how both employers and graduates judge the strengths and weaknesses of the engineering programmes in the light of their experience. As a particularly extensive and informative study, this offers, for the first time, a national perspective on these issues. More than half of all Irish NFQ Level 8 engineering graduates come from the institute of technology sector: a measure of the significance of the contribution of the Institutes' engineering schools to the economy and to Ireland's competitiveness as a knowledge economy.

QUALITY ASSURANCE PROCESSES

Quality is at the core of the Institutes' offerings: the Institutes implement rigorous Quality Assurance procedures in respect of the development and maintenance of their programmes, with consultation with employers and graduates as a central component. All Institutes use such consultation as part of their evaluation of the rationale for the design, development, updating and withdrawal of taught programmes.

Embedded in the day to day operations of the Institutes are a number of review processes that assure the academic integrity of programmes of study and their relevance to national and regional strategies, while complying with selected professional body standards. Already, there is extensive consultation with industry, students, graduates, state agencies and demonstrable compliance with relevant reports. The most common mechanism used to consult with employers is the assembly of dedicated industrial advisory boards made up of experts drawn from relevant industrial and enterprise groups. Academic integrity of programmes is supported by a series of processes that include institutional reviews, programmatic reviews, programme boards, quality committees and academic councils, as summarised in Figure 37. This report will find a ready, open and mature system of quality assurance, a basic platform for further enquiry and implementation.

This study adds a new dimension in both scale and depth to data currently gathered through existing consultation and review methods. The granularity of the information gathered at institute level is often very focused on, and targeted at, a particular engineering discipline. We now have a larger and broader view of how our graduates are performing.

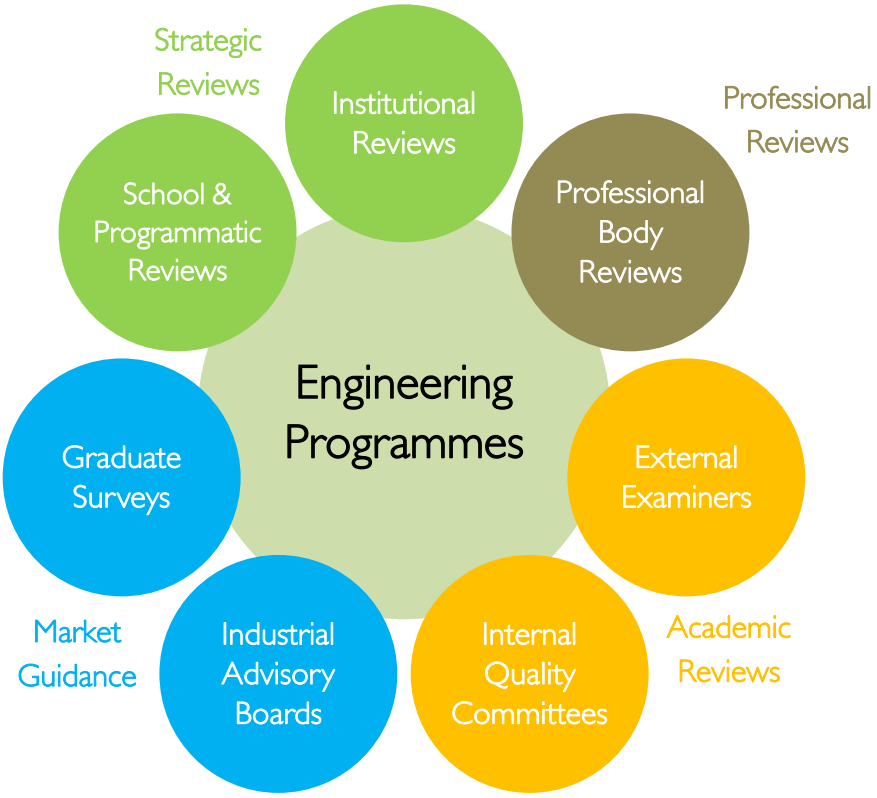


Figure 37: Quality Assurance framework within the Institutes of Technology

EMPLOYERS' PERCEPTION OF OUR GRADUATES

Perception is vital. We are heartened by the substantive findings, confirming that our graduates are held in high regard by employers and providing a strong endorsement of the relevance and currency of the education and quality systems in place in the Institutes. The formation of engineers in the Institutes is applied in nature, the route taken to graduation reflective of industrial needs. This ambition is achieved while fulfilling NFQ Level 8 engineering degree standards, set within the National Framework of Qualifications by the Institutes and by HETAC through its sectoral framework. Engineering graduates of NFQ Level 8 programmes at the Institutes are performing well in industry, on a par technically with graduates from institutions, and they are well prepared for the workplace.

Our report offers important lessons. Among the more interesting findings is the identification of what employers feel is most important and less well addressed in engineering education. Communication with fellow professionals and with society at large is a core engineering skill. Programmes are changing to make this aspiration tangible. The ability of graduates to communicate well, both in oral and written form, is identified as deserving greater emphasis. So too is the requirement to have our graduates made more commercially aware, to be more familiar with industrial practices, to be informed by research and to be able to reach out to the wider community. There are calls for more placements, more site visits, and greater emphasis

on industry standard reporting practices and for engineering education to be informed by research.

PUBLIC PERCEPTION

Again on perception, one interesting finding is that while employers are very satisfied with the quality of institute of technology engineering graduates, the graduates themselves perceive that the general public does not hold the qualification from an Institute of Technology in equal esteem to those from a University. While such impressions are not changed overnight, this report, in concert with future action, should help to correct this perception.

GOOD PRACTICES AT THE INSTITUTES

There are many good practices evident at the Institutes that address issues raised by the employers. Increasingly, engineering schools are embedding industrial practices in their programmes, employing industrial experts to deliver relevant and up to date material. Co-sponsored degree programmes in targeted domains, are a feature of some engineering school portfolios, initiated in response to an upskilling need in the workplace. The provision of add-on one year NFQ Level 8 engineering degrees is providing opportunities to students and industries to up-skill in relevant domains.

Across every engineering discipline, strong links have been forged by the Institutes to regionally based industries. Team based projects, problem based learning and frequent presentations to peers and industrial representatives feature increasingly in engineering programmes, and it is clear that industry wants to see more. It is now common for final year engineering students to present posters on their projects to the wider public, affording them the opportunity to communicate engineering problems and solutions widely. Industrial placements are increasingly standard practice on engineering programmes, the cost to the Institutes far outweighed by the benefits to the graduates and to industry.

CHALLENGES

The challenge now is to make the adoption of these and other good practices more widespread, if not standard across the Institutes. There is a challenge too, to create a greater bond with industry, one that works collaboratively to further engineering education. It is heartening to note that there is a real appetite in industry to engage collaboratively with the Institutes, to address some of these issues.

Other challenges include making industry, particularly multi-nationals aware of the growing research capacity at the Institutes, now well established and with a strong applied emphasis. There are follow-on benefits to our engineering undergraduates ensuring that their formation as engineers is informed by research.

The report tells us clearly that communications skills, both oral and written could be better, the commentary forthcoming from graduates and industry representatives alike. While there has been an understanding within the Institutes of the communications deficit of our engineering graduates and also within the engineering professional body Engineers Ireland, it is clear that more needs to be done, almost inevitably involving a more concerted effort that also challenges first and second level education.

Teaching and learning has traditionally been a strong feature of the culture of education at the Institutes. The challenge of continuous up-skilling of staff to explore and exploit new teaching methods is critical to more flexible and effective delivery of engineering programmes. Every school of engineering has made significant strides in these areas to which the survey results providing a reassuring testament.

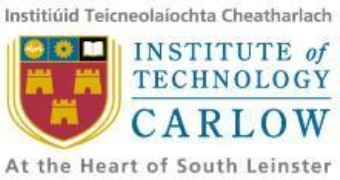
Conclusion

We are encouraged by the study results and by the level of collaboration between Institutes, of which this study is a good example. There are good practices in many Institutes, and the strong network that now exists among senior academics, external examiners and programme panel members across the HEIs supports their more widespread adoption. We look forward to working together within our own Institutes and collaboratively to continue to improve the quality of engineering education in Ireland.

7 APPENDIX: NFQ LEVEL 8 PROGRAMMES

The following is the complete list of institute of technology NFQ Level 8 programmes whose graduates were invited to complete the graduate survey. Some of these programmes were offered in more than one Institute. In these cases the number of Institutes where the programme was offered is included in brackets.

B.Eng. (Hons) Civil Engineering (*2 Institutes*)
B.Eng. (Hons) Computer Engineering
B.Eng. (Hons) Electronic Engineering
B.Eng. (Hons) Embedded System Design
B.Eng. (Hons) Integrated Manufacturing Systems
B.Eng. (Hons) Mechanical Engineering
B.Eng. (Hons) Mechatronics
B.Eng. (Hons) Software Engineering
B.Eng. Building Services Engineering
B.Eng. Chemical & Process Engineering
B.Eng. Civil Engineering (*2 Institutes*)
B.Eng. Computer & Communications Engineering
B.Eng. Computer Engineering
B.Eng. Digital & Software Systems Engineering
B.Eng. Electrical/Electronic Engineering
B.Eng. Electronic Engineering (*3 Institutes*)
B.Eng. Industrial Engineering
B.Eng. Manufacturing Engineering (*2 Institutes*)
B.Eng. Mechanical Engineering (*5 Institutes*)
B.Eng. Mechatronics
B.Eng. Polymer Engineering
B.Eng. Product Design
B.Eng. Product Design Engineering
B.Eng. Structural Engineering (*2 Institutes*)
B.Sc. (Hons) Applied Electronics
B.Sc. (Hons) Computer & Software
B.Sc. (Hons) Computer Aided Manufacturing
B.Sc. (Hons) Computing
B.Sc. (Hons) Computing/Computer Services Management
B.Sc. (Hons) Construction Management (*2 Institutes*)
B.Sc. (Hons) Construction Technology & Management
B.Sc. (Hons) Construction with Quantity Surveying
B.Sc. (Hons) Electronic Systems
B.Sc. (Hons) Fire Technology/Fire Safety Engineering
B.Sc. (Hons) Integrated Circuit Engineering
B.Sc. (Hons) Manufacturing Systems Engineering
B.Sc. (Hons) Polymer Technology
B.Sc. (Hons) Property Studies
B.Sc. Advanced Manufacturing Technology
B.Sc. Agricultural Engineering Management
B.Sc. Architectural Technology
B.Sc. Building Engineering & Management - Construction Management
B.Sc. Building Surveying
B.Sc. Construction Economics & Management - Quantity Surveying
B.Sc. Construction Management (*2 Institutes*)
B.Sc. Electrical Power Systems
B.Sc. Facilities Management
B.Sc. Integrated Circuit Engineering
B.Sc. Manufacturing Engineering Management
B.Sc. Process Plant Technology
B.Sc. Product Design
B.Sc. Property Valuation & Management - Real Estate
B.Sc. Quality Management
B.Sc. Quality Management & Technology
B.Sc. Quantity Surveying (*2 Institutes*)
B.Sc. Transport Operations & Technology
B.Sc. Transport Technology
B.Tech. Integrated Manufacturing Systems
B.Tech. Production Technology
BA (Hons) Interior Architecture
Dip. Building Services Engineering
Dip. Electrical/Electronic Engineering
Dip. Manufacturing Engineering
Dip. Mechanical Engineering
Dip. Structural Engineering
H.Dip. Engineering Highway Technology
H.Dip. Science Computing
H.Dip. Science Quality



Waterford Institute *of* Technology
INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE