Institiúid Teicneolaíochta Chorcaí
Cork Institute of Technology

School of
Science and Informatics

Programmatic Review Submission

Strategic Review Stage

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School of Science and Informatics

School of Science and Informatics

1 Overview

The School of Science and Informatics has recently been established from the School of Science, which was comprised of three departments:

- Department of Applied Physics and Instrumentation
- Department of Biological Sciences
- Department of Chemistry

and the School of Computing and Mathematics, which was comprised of two departments:

- Department of Computing
- Department of Mathematics

Within this new School of Science and Informatics (outlined above) each Department is led by a Head of Department:

Dr Liam Mc Donnell, Department of Applied Physics and Instrumentation
Dr Brendan O'Connell, Department of Biological Sciences
Dr John Wood, Department of Chemistry
Mr. Jim O'Dwyer, Department of Computing
Dr David Flannery, Department of Mathematics

The School is led by the Head of School of Science and Informatics, Dr Hugh McGlynn.

The merger of the School of Science and the School of Computing and Mathematics occurred in February 2011. The table below lists the numbers and breakdown of staff in each Department.

	Full Time Academic Staff	**CID staff**	**Pro-Rata Staff**	**Technical Staff**	**Administrative Staff**	**Research Active Staff**
Applied Physics & Instrumentation	12	4	0	4	0.5	4
Biological Sciences	17	3	0	5	0.5	6
Chemistry	9	0	0	4	0.5	2
Computing	26	2	1	0	0.5	3
Mathematics	11	4	9	1	0.5	3
Total	75	13	10	13	2.5	18

Table 1.1. Staff numbers in the Departments of the school of Science and Informatics

1.1 Academic Quality System

The Academic Quality System (AQS) operates in parallel to the executive management structure. Developed through the Academic Council and approved by the Higher Education and Training Awards Council (HETAC), the AQS confers key quality assurance roles on (a) Faculty Board of Studies (FBS), (b) Academic Departments and (c) Course Boards.

Faculty Board of Studies:

Terms of Reference:

- The Faculty Board of Studies addresses matters relating to the planning, co-ordination, development and overseeing of the educational work of the Faculty.

These matters include, inter alia,

- Academic Review
- Academic Planning
- Research & Development
- Admissions
- Examinations
- Learning Resources

- The FBS may appoint standing committees and working committees;
- The FBS normally meets at least one per term, with provision to convene further meetings as necessary. The Head of Faculty publishes a schedule of meetings at the beginning of each academic year.
- The Faculty Board of Studies reports to the Faculty Executive Board. The minutes of the Faculty Board of Studies are issued to the Academic Council through the Head of Faculty and are placed on the Intranet.

Membership:
The membership of the Faculty of Engineering & Science Board of Studies (Appendix 1) comprises:

- Head of Faculty (Chair)
- Registrar (or nominee)
- Heads of School
- Heads of Department
- Heads of Section
- Two members of the Apprenticeship Board of Studies, where appropriate
- Senior Lecturers (Teaching)
- Other nominees of the Faculty Executive Board, as appropriate

The Faculty Administrator attends the meetings of the Faculty Board of Studies.

Departments: The departments are the core academic units within CIT, with ownership and responsibility for courses residing primarily within them. Departments are

managed by the Head of Department (HoD), who is a member of the School Executive and of the Senior Staff Forum. Departmental staff meetings are an important forum for discussion and information purposes and are critical to achieving the co-operation and partnership on which the academic quality of the Institute depends. The composition of the departmental staff meeting comprises all academic, technical and administrative staff in the department. The Academic Management Handbook recommends that there should be two such meetings per term.

Course Boards: Each undergraduate and post-graduate course or suite of courses is required to operate under the aegis of a course board

Course Boards – Functions:

- Monitor the operation of the courses including examinations, entry and transfer;
- Prepare annual course monitoring reports and submit these as appropriate through the HoD to the Registrar's Office;
- Make proposals regarding the operation of courses;
- Plan course developments;
- Carry out a self-study of the course for the Programmatic Review;
- Assist with the preparation of the Programmatic Review;
- Partake as appropriate in the Programmatic Review.

Course Boards – Formation and Membership:

- The Head of Department has responsibility for nominating the membership and chair of the Course Board;
- The composition shall be:
  Head of Department (ex officio) or nominee;
  Lecturers (5-6) representing key subject areas, including service;
  Student representation

1.2 Department of Applied Physics and Instrumentation

1.2.1 Programme Portfolio

The Department of Applied Physics and Instrumentation holds delegated authority up to level 10 of the National Framework of Qualifications develops and operates a range of programmes in the following:

- **LEVEL 6**
  - Higher Certificate in Science in Industrial Measurement and Control (*ab initio*, part-time)
- **LEVEL 7**
  - BSc in Applied Physics and Instrumentation (full-time and part-time)
- **LEVEL 8**
  - BSc (Hons) in Applied Physics and Instrumentation (add-on, full-time and part-time)
  - BSc (Hons) in Environmental Science & Sustainable Technology (*ab initio*, full-time)
  - BSc (Hons) in Instrument Engineering (*ab initio*, full time)
- **LEVEL 9**
  - MSc (by research)
- **LEVEL 10**
  - PhD (by research)

In response to the recent Government Labour Market Activation initiative, the Department developed a suite of special purpose programmes, as follows:

- **LEVEL 6**
  - Certificate in Measurement & Calibration
  - Certificate in IT & Automation
  - Certificate in Process Control & Automation
  - Certificate in Process Instrumentation

- **LEVEL 8**
  - Certificate in Advanced Industrial Automation

1.3 Department of Biological Sciences

1.3.1 Programme Portfolio

The Department of Biological Sciences holds delegated authority up to level 10 of the National Framework of Qualifications develops and operates a range of programmes in the following:

- **LEVEL 7**
  - BSc in Applied Sciences with Biotechnology (full-time)

- BSc in Food Science and Health (full-time)

- **LEVEL 8**
  - BSc (Hons) in Applied Biosciences (part-time)
  - BSc (Hons) in Herbal Sciences (*ab initio*, full-time)
  - BSc (Hons) in Biomedical Sciences (*ab initio*, full-time)
  - BSc (Hons) in Pharmaceutical Biotechnology (*ab initio*, full-time)
  - BSc (Hons) in Nutrition and Health Science (*ab initio*, full-time)

- **LEVEL 9**
  - MSc in Biomedical Sciences (part-time)

- **LEVEL 10**
  - PhD (by research)

1.4 Department of Chemistry

1.4.1 Programme Portfolio

The Department of Chemistry holds delegated authority up to level 10 of the National Framework of Qualifications develops and operates a range of programmes in the following:

- **LEVEL 6**
  - CIT Certificate in Quality Assurance (Special Purpose Award)
  - Diploma in Quality Management, Parts 1 and 2 (Excellence, Ireland)

- **LEVEL 7**
  - BSc in Analytical and Pharmaceutical Chemistry (part-time, full-time)
  - BSc in Science Common entry (full-time)

- **LEVEL 8**
  - BSc (Hons) in Analytical Chemistry with Quality Assurance (*ab initio*, full-time)
  - BSc (Hons) in Science Common Entry (full time)

- **LEVEL 9**
  - MSc (by research)

- **LEVEL 10**
  - PhD (by research)

1.5 Department of Computing

1.5.1 Programme Portfolio

The Department of Computing, which holds delegated authority up to level 9 of the National Framework of Qualifications, develops and operates a range of programmes in the general categories of:

A) Software Development
B) Networking
C) IT Support
D) IT in Education

Details of the specific programmes delivered are provided below, with programme categories being designated as A, B, C or D as appropriate in line with the category details listed above.

- **LEVEL 6**
  - Higher Certificate in Science in IT Support (*ab initio*, full-time, C)
  - Higher Certificate in Science In Computing (*ab initio*, full-time embedded and part-time, A)

- **LEVEL 7**
  - BSc in IT Support (add-on award, full-time and part-time, C)
  - BSc in Computing (full-time, A)

- **LEVEL 8**
  - BSc (Hons) in Software Development (*ab initio*, full-time, A)
  - BSc (Hons) in Software Development & Computer Networking (*ab initio*, full-time, B)
  - *BSc (Hons) in IT Management (*ab initio* and add-on award, full-time and part-time, C)
  - BSc (Hons) in Web Development (full-time A).

- **LEVEL 9**
  - MSc In Software Development (taught, full-time and part-time, A)
  - *MSc in Networking & Security (taught, full-time and part-time, B)
  - *Postgraduate Diploma in Networking & Security (taught, full-time and part-time, B).
  - MSc (Computing) (by research, A)

  - **Postgraduate Diploma in Computing in Education (taught, part-time, D)**
  - **MSc in Computing in Education (taught, part-time, D)

- **LEVEL 10**
  - PhD (Computing) (by research)

* Introduced since the last programmatic review
** Not run in last two years and being discontinued.

In addition to the above, the Department of Computing delivers a suite of professional programmes, as follows:

Cisco Academy.
  - Cisco Certified Network Associate (CCNA)
  - ***Cisco Certified Network Professional (CCNP)

CCNP Introduction

- ***Building Cisco Multilayer Switched Networks
- ***Building Scalable Cisco Internetworks
- ***Implementing Secure Converged Wide Area Networks
- ***Optimising Converged Cisco Networks

Microsoft Academy

- ***Introduction to Developing Web Applications Using Microsoft Visual Studio
- ***Microsoft Certified Technical Specialist: Developing and Implementing Web Applications with C#.NET
- ***Introduction to Windows Server
- ***Microsoft SQL Server, Implementation and Maintenance

CompTIA Academy

- ***CompTIA A+
- ***CompTIA Server+
- ***CompTIA Network+

Novel Academy

- ***Novell's Certified Linux Professional (CLP).

VMware Academy

- ***VMware vSphere: Install, configure, manage.

*** Introduced since the last programmatic review

In response to the recent Government Labour Market Activisation initiative, the Department developed a suite of special purpose programmes, as follows:

- **Level 6**
  - Certificate in Computer Networking
  - ****Certificate in IT System Maintenance
  - Certificate in IT Fundamentals and Training
  - Certificate in Web Development Fundamentals

- **Level 8**
  - Certificate in eBusiness Technologies

- **Level 9**
  - ****Certificate in Advanced Software Development

**** These programmes were approved subsequent to development for operation by the HEA.

1.6 Department of Mathematics

The Department of Mathematics provides a teaching service across the Institute as well as providing specialist laboratory facilities to its "client" departments. Its lecturers operate:

- In 15 departments;
- Spanning 8 schools; and
- Participating in programmes which span the wide range from apprentice mathematics and craft calculations to final year professional engineering.

Subject areas covered include: mathematics, biomathematics, statistics, statistical quality control, quantitative techniques, operations research and numerical methods. In addition, staff provide instruction in computing where this is linked to a mathematics course. This ranges from computer studies for science students to FORTRAN programming for engineering students. See the relevant attachments for full details of the portfolio of modules in mathematics and statistics taught by staff from the Department of Mathematics.

Staff members of the Department of Mathematics participate fully in relevant course development and review teams across the Institute. Retention teaching programmes are provided for students in mathematics and statistics. As students in CIT are credited to their home departments, the Department of Mathematics cannot claim any students of its own. Nevertheless, the number of full-time equivalent students of the Department of Mathematics is in the region of 300 when calculated on the basis of credits delivered and class sizes taught.

While the Department is not the sole provider of mathematics' teaching in the Institute (as some teaching of mathematics is provided by lecturers from other departments), it caters for the vast majority of the Institute's needs in this regard. It provides a sound structure upon which to provide lecturers in mathematics with professional development options, career progression options and recognition for the very significant contribution which they make in an increasingly important area of education.

1.7 CAO Application statistics for Level 7 and Level 8 Programmes within the School 2006-2010.

	2006	2007	2008	2009	2010
CR001 BSc Applied Physics & Instrumentation	229	227	177	229	204
CR006 BSc Applied Biosciences	729	644	450	630	771
CR007 BSc Analytical Chemistry	424	378	270	319	312
CR016 BSc Computing	650	705	639	646	796
CR085 BSc Biomedical Science	810	884	817		
CR300 BSc Science Common Entry	-	-	-	147	765
CR888 BSc Information Technical Support	204	178	190	223	282

Table 1.2: CAO Level 7 Programme Application Statistics 2006-2010

Analysis of Trends

The key points to note from this table are as follows:

1. Full-time undergraduate enrolment levels have fallen significantly since the completion of the most recent Programmatic Review of the School;
2. A very significant fall in the number of application for all courses within the school occurred in 2008. A number of possible reason for this drop were: overall reduction in number of students taking the Leaving certificate in this year as a consequence of demographic changes, fall in countries economic outlook which may have resulted in an adverse outlook towards third-level study.
3. After a period of significant turbulence, application performance appears to have stabilised, with increases in overall application levels evident for most programmes in 2009 and 2010. A significant resurgence in the IT and Computing sector has been met by a significant rise in applications in this area.
4. Steps were taken in 2008 to address fall in applications with the introduction of the Level 7 BSc Science common entry programme.
5. The BSc Biomedical Sciences was replaced with *ab inito* BSc Hons Biomedical Sciences

CAO Level 8 Programme Application Statistics 2006-2010

	2006	2007	2008	2009	2010
CR106 BSc Hons Software Development	467	433	440	391	460
CR111 BSc Hons Computerised Instrument Systems	155	132	127	80	-
CR116 BSc Hons Software Development with Networking	395	397	408	360	411
CR305 BSc Hons Science Common Entry	-	-	-	139	325
CR310 BSc Hons IT Management	-	-	104	245	348
CR320 BSc Hons Biomedical Science	-	-	-	604	750
CR325 BSc Hons Pharm Biotechnology	-	-	-	120	250
CR330 BSc Hons Herbal Science	161	227	199	177	182
CR333 BSc Hons Nutrition & Health Science	-	-	-	218	686
CR340 BSc Hons Analytical Chemistry with QA	-	-	27	57	77
CR360 BSc Hons Instrument Engineering	-	-	-	52	100
CR365 BSc Hons Environmental Science & Sustainable Technology	-	-	-	-	57

Table 1.3. CAO Level 8 Programme Application Statistics 2006-2010

Analysis of Trends

The key points to note from this table are as follows:

1. The number of applications to Level 8 courses has remained relatively stable over the period under investigation. Strategically the School has engaged in the ladder approach of Level 8 add-ons and in the development of *ab-initio* Level 8 programmes. This has seen overall figures rise.
2. Steps were taken in 2008 to address fall in applications to the Physical Sciences (i.e. Physics and Chemistry) with the introduction of the Level 8 BSc Hons Science common entry programme in 2009. Applications are continuing to rise in this course.

1.8 Registration Statistics for Level 7 and Level 8

Programmes within the School 2006-2010.

	2006	2007	2008	2009	2010
CR001 BSc Applied Physics & Instrumentation	22	25	26	12	22
CR006 BSc Applied Biosciences	75	55	67	45	50
CR007 BSc Analytical Chemistry	40	20	17	19	16
CR016 BSc Computing	37	51	53	49	46
CR085 BSc Biomedical Science	31	32	29	26	-
CR300 BSc Science Common Entry	-	-	-	12	10
CR888 BSc Information Technical Support		60	25	26	34

Table 1.4. Registration Statistics of students in Year 1 of Level 7 programmes within the School 2006-2010

Analysis of Trends

The key points to note from this table are as follows:

1. Full-time undergraduate registration levels have fallen significantly since the completion of the most recent Programmatic Review of the School;
2. A very significant fall in the number of registrations for courses within the school occurred in 2008. A number of possible reason for this drop were: overall reduction in number of students taking the Leaving certificate in this year as a consequence of demographic changes, fall in countries economic outlook which may have resulted in an adverse outlook towards third-level study.
3. Registration numbers appear to have stabilized in 2009 and 2010. A significant resurgence in the IT and Computing sector has been met by a significant rise in registrations in this area.

Registration Statistics of students in Year 1 of Level 8 programmes within the School 2006-2010

	2006	2007	2008	2009	2010
CR106 BSc Hons Software Development	18	25	21	23	14
CR111 BSc Hons Computerised Instrument Systems	10	12	7	-	-
CR116 BSc Hons Software Development with Networking	22	20	12	8	12
CR305 BSc Hons Science Common Entry	-	-	-	8	8
CR310 BSc Hons IT Management	-	-	-	6	8
CR320 BSc Hons Biomedical Science	-	-	-	66	32
CR325 BSc Hons Pharm Biotechnology	-	-	-	26	22
CR330 BSc Hons Herbal Science	12	21	14	17	20
CR333 BSc Hons Nutrition & Health Science	-	-	-	33	44
CR340 BSc Hons Analytical Chemistry with QA	-	-	-	9	7
CR360 BSc Hons Instrument Engineering	-	-	-	-	2
CR365 BSc Hons Environmental Science & Sustainable Technology	-	-	-	-	25

Table 1.5. Registration Statistics of students in Year 1 of Level 8 programmes within the School 2006-2010

Analysis of Trends

The key points to note from this table are as follows:

1. Strategically the School has engaged in the ladder approach of Level 8 add-ons and in the development of *ab-initio* Level 8 programmes. This approach also led to the discontinuation of registration onto 'non-performing' courses in respect to applications. This included BSc Hons Computerised Instrument Systems. Thus the overall figure for registration onto Level 8 courses has risen since 2005.
2. Steps were taken in 2008 to address fall in applications to the Physical Sciences (i.e. Physics and Chemistry) with the introduction of the Level 8 BSc Hons Science common entry programme in 2009. Applications are continuing to rise in this course.

1.9 Retention Statistics for Level 7 and Level 8 Programmes within the School 2007-2010.

Current analysis of retention takes a year-on-year view of full time students, and defines retention as the percentage of students registered on the 1st of November in a given year who one year later have either progressed to the next programme stage, completed their studies and received an award, registered again to repeat the same programme stage, or registered on to a new CIT programme.

The retention statistics for the full time students in CIT faculties/Colleges is listed below:

Faculty/ College	**2007**	**2008**	**2009**
Engineering	85.5%	86.3%	87.8%
Science	75.5%	81.1%	85.1%
Business & Humanities	84.3%	86.4%	89.5%
Art & Design	89.5%	92.4%	91.5%
Music	95.4%	97.1%	92.7%
NMCI	81.0%	92.1%	89.2%

Table 1.6. Retention statistics of students in fulltime courses in CIT (2007-2009 exam periods).

Retention Statistics for Level 7 and Level 8 Programmes within the School 2007-2010.

Course	2007	2008	2009	2010
BSc in Computing Y1	59	85	86	91
BSc in Computing Y2	78	84	82	79
BSc in Computing Y3	80	93	100	91
BSc Comp Services Management Y4	83	80	86	80
BSc Software Dev & Comp Network Y1	60	69	88	75
BSc Software Dev & Comp Network Y2	83	86	89	71
BSc Software Dev & Comp Network Y3	83	89	85	100
BSc Software Dev & Comp Network Y4	100	53	88	85
Higher Cert IT Management Y1	-	-	83	100
Higher Cert IT Management Y2	-	-	-	100
Higher Cert Info Tech Support Y1	77	72	88	85
Higher Cert Info Tech Support Y2	84	76	53	95
BSc Info Tech Support Y3	67	92	94	100
BSc (Hons) Software Development Y1	64	57	91	71
BSc (Hons) Software Development Y2	100	63	75	92
BSc (Hons) Software Development Y3	83	81	89	94
BSc (Hons) Software Development Y4	93	83	92	87
BSc Comp Instrument Systems Y1	50	57	100	-
BSc Comp Instrument Systems Y2	100	80	100	100
BSc Comp Instrument Systems Y3	83	100	67	100
BSc Comp Instrument Systems Y4	100	83	100	100
BSc Hons Instrument Eng Y1	-	-	-	100
BSc App Physics & Instrumentation Y1	76	85	75	95
BSc App Physics & Instrumentation Y2	76	89	95	100
BSc App Physics & Instrumentation Y3	86	74	100	90
BSc (Hons) App Phys &Instrumentation Y4	86	41	100	69
BSc Ap Biosciences & Biotechnology Y3	95	95	100	100
BSc Food and Health Y3	100	77	100	100
BSc Applied Biosciences Y1	82	81	98	92
BSc Applied Biosciences Y2	88	94	87	95
BSc Hons Applied Biosciences Y4	88	97	-	-
BSc Biomedical Science Y1	88	97	100	-
BSc in Biomedical Science Y2	100	96	100	97
BSc in Biomedical Science Y3	100	78	96	100

Table 1.7. Retention Statistics for Programmes within the School of science and Informatics 2007-2010

Retention Statistics for Level 7 and Level 8 Programmes within the School 2007-2010 contd.

BSc (Hons) Biomedical Science Y1	-	-	-	97
BSc (Hons) Herbal Science Y1	57	93	88	80
BSc (Hons) Herbal Science Y2	75	91	90	100
BSc (Hons) Herbal Science Y3	-	100	90	89
BSc (Hons) Herbal Science Y4	-	-	100	100
BSc (Hons) Nutrition & Health Sci Y1	-	-	-	84
BSc (Hons) Nutrition & Health Sci Y4	-	-	-	100
BSc (Hons) Pharmaceutical Biotech Y1	-	-	-	100
BSc (Hons) Pharmaceutical Biotech Y4	-	-	-	100
BSc Analytical Chem with QA Y4	67	38	100	88
BSc Analytical & Pharm Chem Y1	70	94	95	88
BSc Analytical & Pharm Chem Y2	88	93	100	100
BSc Analytical & Pharm Chem Y3	92	87	100	97
BSc (Hons) Analytical Chemistry QA Y1	-	-	100	100
BSc Hons Analytical Chemistry QA Y2	-	-	-	100

Table 1.7. (Contd)Retention Statistics for Programmes within the School of science and Informatics 2007-2010

1.9.1 Reasons for Non-Completion:

As shown above, significant numbers of students either do not stay the distance and "drop-out" of the course for various reasons before the examinations or, where they do sit the examinations, fail to progress, especially in first year. A number of possible causes have been identified:

Leaving Certificate Points:
Leaving Certificate points have been proven to be an indicator of suitability and level of performance in third-level courses. It has been indicated that students registered on Level 8 courses with less than 300 points perform poorly and also students registered on level 7 courses with 250 points or less perform equally badly. It has also been shown that Leaving Certificate Maths performance/attainment has been correlated with performance in third-level, with students attaining hours grades in the hours Maths performing better.

- **Working**: A survey of 173 current School of Science students in late 2009 (Appendix) shows that over 51.2% of those surveyed are in paid employment. Furthermore, of those in employment, 54% work 10 hours or more per week, with 29.2% working 15 hours or more

1.10 Graduate & Postgraduate Statistics.

Graduate statistics presented in Table 1.8 shows that School graduations decreased from 2005 to 2009, reflecting a difficult period of recruitment and retention for Science and Computing programmes.

Title of Award	**2005**	**2006**	**2007**	**2008**	**2009**
HC Applied Physics & Instrumentation	16	16	9	9	2
HC Industrial Measurement & Control	1	8	-	-	-
BSc Applied Physics & Instrumentation	30	27	27	27	17
BSc (Hons) Applied Physics & Instrumentation.	35	32	19	17	18
BSc (Hons) Comp. Instrument Systems	6	7	4	4	2
Applied Physics & Instrumentation	**88**	**90**	**59**	**57**	**39**
HC Applied Biosciences	37	37	30	1	-
BSc Applied Biosciences & Biotech	29	30	18	18	19
BSc Food Science & Technology	19	12	19	15	8
BSc (Hons) Biosciences	30	36	55	30	46
BSc (Hons) Herbal Science	-	-	-	-	5
BSc Biomedical Science	33	32	36	49	34
Biological Sciences	**148**	**147**	**158**	**113**	**112**
HC Chemistry	23	19	18	-	-
BSc Analytical & Pharma Chemistry	25	31	20	26	18
BSc (Hons) ACQUA	20	20	13	4	17
Chemistry	**68**	**70**	**51**	**30**	**35**
Level 6	23	17	15	26	15
Level 7	33	25	33	27	27
Level 8	103	69	35	27	25
Computing	**159**	**111**	**83**	**80**	**67**
Total	**463**	**418**	**351**	**280**	**253**

Table 1.8. Science Graduate Statistics by Award 2005-09

Postgraduate Statistics: The data for postgraduate statistics in Table 1.9 demonstrate the significant input of the School into the Institute's postgraduate activity, especially research Masters and PhD.

Postgraduate Research Students	**2005**		**2006**		**2007**		**2008**		**2009**	
	MSc	**PhD**	**MSc**	**PhD**	**MSc**	**PhD**	**MSc**	**PhD**	**MSc**	**PhD**
Applied Physics & Instrumentation	1	-	-	-	-	-	1	1	3	2
Biological Sciences	1	-	3	2	3	-	4	1	2	2
MSc (Taught) Biomedical Science	-	-	-	-	16	-	8	-	-	-
Chemistry	-	4	1	-	-	2	2	-	-	1
Computing	17	2	7	1	16	0	10	1	12	1
Total	19	6	11	3	35	2	25	3	17	6

Table 1.9. Postgraduate Research Student Statistics by Award 2005-09

1.10.1 Employment & Further Studies

Detailed information on employment and further studies for graduates will be presented by the individual departments in phase 2 documentation. From the School's perspective, a survey of 116 graduates was conducted in late 2009 and this offers some interesting insights into the employment opportunities and views of course undertaken for graduates of science and computing in CIT.

This data is summarised in the following table (a more detailed account of the questionnaire applied and individual responses is included in Appendix – Student Surveys)

Employment	
➢ Currently in Employment	72.4%
Industry Sector employed	
➢ Chemical	3.0%
➢ Biotechnology	1.5%
➢ Food	6.1%
➢ IT/Software	40.9%
➢ Electronics	6.1%
Value of CIT qualification in your career (important)	
➢ Gave first job	76.9%
➢ Opened a range of career choices	88.2%
Value of CIT qualification in Industry	
➢ High	53.7%
➢ Medium	41.8%
➢ Low	4.5%
Rate Facilities (good or better)	
➢ Classrooms	35.1%
➢ Laboratories	70.3%
➢ Library	68.5%
Course Content (agree)	
➢ Balance Theory & Labs correct	77.1%
➢ Balance Fundamentals & application correct	68.6%
➢ Balance soft skills & technical content	60.9%
Would you recommend your course to others	
➢ Yes	77.5%
➢ No	5.6%
➢ Maybe	16.9%

Table 1.10 Summary of Key Findings of Science and Computing Graduate Survey 2009.

2 External Environment Analysis

Executive Summary

In common with similar entities across Ireland, the School of Science and Informatics in CIT has faced many challenges. Until recently, falling application levels for full-time physical sciences and computing programmes have given rise to a range of challenges for students and for the School. In addition, many well documented challenges to the effective learning of science and mathematics continue to exist at primary and post primary levels. Despite these challenges, the School has achieved much during the past 5 year period and is well-placed to provide new opportunities for all of its stakeholders over coming years through provision of a comprehensive portfolio of student-centric offerings, a strong focus on research, solid industry engagement and pursuit of new international opportunities.

The School's vision, derived from the Institute's Strategic Plan, reads as follows:
To be a pre-eminent provider of career-focused education and research, in science and informatics, in a manner that embraces diversity and innovation.

The School's mission statement, derived from the Institute's Strategic Plan, reads as follows:

> *To provide student-centered education, in science and informatics, with a career focus for the benefit of the personal, intellectual and professional development of the student and for the benefit of the whole of society.*

To achieve its vision and mission, the School will pursue the initiatives depicted below (Figure 2.1) and described in detail in the main body of this document.

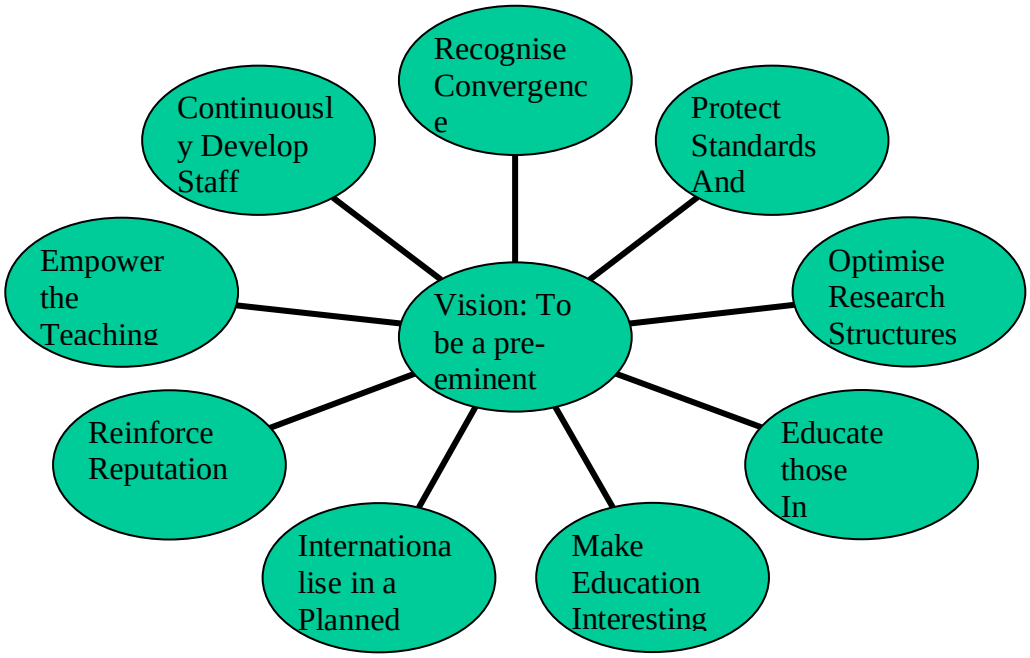

Figure 2.1: School of Science and Informatics Strategic Initiatives

2.1 The National and International Perspective

The School of Science and informatics has operated in a very challenging environment in recent years.

Concerns exist that relatively low student numbers in the Science and Mathematics areas will have a detrimental impact on efforts to attract research and development (R&D) and build a knowledge economy. Indeed, the strategy document Building Ireland's Smart Economy: A Framework for Sustainable Economic Renewal (2008) recognises that science-based technology forms one of the cornerstones of the economy and that utilising the knowledge, skills and creativity of people is central to developing innovation and ideas.

While the numbers of science students taking the higher level papers in the Leaving Certificate are relatively high compared to Maths, there are low levels of participation in physics and chemistry. International research shows that these trends in Maths and science are also evident in many other countries. Analysing CAO entry requirements, it has been shown that the high achievers are not selecting to study general science, engineering and technology courses. There is ongoing review of education curricula in Ireland and currently both Maths and science curricula are undergoing changes that are currently being tested by the Department of Education and Science (Oireachtas Spotlight Report, 2009 attached). In 2003, the National Council for Curriculum and Assessment (NCCA) introduced a new curriculum for the teaching and assessment of science in the Junior Certificate. Among the major changes was an increased emphasis on scientific investigation and the application of scientific processes. At present, the NCCA is working to revise the syllabuses in Leaving Certificate Biology, Chemistry and Physics. As part of this review, the NCCA has proposed changes in the area of assessment with a greater emphasis being placed on practical as well as theoretical examination. This aims to ensure that students will develop deeper levels of knowledge and understanding of science, scientific processes and scientific applications.

The number of CAO first preference applicants in Science/Applied Science in 2005 was 5,047; this number has risen steadily to 7,008 in 2009. This would equate to a 38% rise over the period. There has also been a similar rise in the number of level6/7 applicants reaching 7,347 first preference applicants in 2009. According to the HEA Report, science and computing enrolments represent 12.6% of all full-time enrolments in the university sector compared to 10.1% for IoTs. Looking at enrolments overall across CIT in 2009/10, was 11.5% of the student enrolment is in the School of Science, with 805 whole-time equivalent students being enrolled in the Sciences in 2009/10. This has to be considered in more detail, when considering the applications to the specific areas of science.

The Department of Biological Sciences has seen a significant increase in applications over this period, this is a reflection of the high uptake of Biology by leaving certificate students and the emergence of new courses specifically BSc Hons Biomedical Sciences (joint award with UCC) and BSc Hons Pharmaceutical Biotechnology and BSc Hons Nutrition and Health Sciences. The number of applications in Departments of Chemistry and Physics has not seen this increase in demand.

Below is a table of summary of net changes in number of CAO applications of students in Science courses over the period (2006-10) broken into level 7 and level 8 courses.

Level 7		Total 2006	Total 2007	Total 2008	Total 2009	Total 2010
CR001	Applied Physics & Instrumentation	187	181	105	174	138
CR006	Applied Biosciences	596	508	290	400	529
CR007	Analytical Chemistry	352	318	173	221	233
CR085	Biomedical Sciences	679	725	570		0
CR300	Science Common Entry					501
TOTALS	School of Science	1814	1732	1138	795	1401
	CIT	20110	19387	13785	16072	18390
Level 8						
CR111	Computerised Instrument Systems	104	89	49	61	0
CR305	Science Common Entry				0	206
CR320	Biomedical Sciences				464	620
CR325	Pharmaceutical Biotechnology				65	172
CR330	Herbal Science	107	176	90	118	118
CR333	Nutrition and Health Science				0	462
CR340	Analytical Chemistry with Quality				45	40
CR360	Instrument Engineering				0	80
TOTALS	School of Science	211	265	139	753	1698
	CIT	3750	3289	2238	6101	8563
Level 7+ 8						
TOTALS	Total	2025		1277	1548	3099
	CIT	23860		16023	22173	26953
	% School of Science	8.5%		8.0%	7.0%	11.5%

Table 2.1 CAO applications into School of Science (SoS) 2006-2010

Department	2004	2005	2006	2007	2008	2009	2010
Biological Sciences	363	413	372	369	338	452	527
Applied Physics & Instrumentation	193	160	157	141	84	93	153
Chemistry	126	136	106	94	92	97	99
Common Science						17	26
Science Total	682	709	635	604	514	659	805

Table 2.2: School of Science Enrolment Data 2004 – 2010 on Full-Time Programmes

The Pharma/Biopharmachem industry is one of the pillars of the Irish economy and has experienced significant growth in recent years as evidenced by the following statistics.

- €42.2 billion exports (46% of total manufacturing exports)
- Direct employment 25,300 (an increase of over 50% in ten years).

Currently thirteen of the top fifteen companies in the world have substantial operations in Ireland: Six out of top ten of the world's best selling drugs are produced in Ireland

including Lipitor and Zocor. Products are manufactured for global markets. While foreign-owned companies account for 86% of employment in the sector, there has been rapid growth in employment in indigenous companies.

Looking to the future, Ireland's biotechnology industry in particular is primed for growth due in part to the significant R&D investment in the sector in recent years, with combined public and industry funding of more $1.3 billion committed up to 2013. This is a result of a concerted effort in government policy to build a substantial foundation of world-class science and technology in Ireland's academic institutions and, in particular, the encouragement of strong business and academic collaborations, in which CIT Science and Informatics is playing a significant part.

The global biopharma-pharmachem industry is currently undergoing transformation due mainly to patent expiry and consolidation. This change will inevitably result in job losses in Ireland in the 2010-2015 period. These job losses are likely to be balanced by job gains in the biopharma sector, and pharma companies moving to higher value added activities such as process and product development, and services such as supply-chain management and corporate services. Accordingly, there is a strong onus on CIT to deliver the numbers and required skill sets of graduates to the industry.

The 2010 Expert Group Future Skills Need report on BioPharmaChem sector (see relevant attachment), identified structural trends and drivers of change that will have greatest impact on numbers employed in this sector and skills requirements during 2010-2015.

The main recommendations of this working group were:

1. To Align education and training provision with the industry's requirements

- Ensure science and technology programmes are aligned with industry's needs on an ongoing basis. Industry to ensure that it keeps education and training providers informed of its requirements.
- Informatics, bio-informatics, business and generic skills will need to be embedded into Science and Technology programmes
- Ensure that CPD provision continually meets industry needs and can be delivered in a flexible manner.

2. To Enhance Industry-Academia Collaboration

- Formal structures and processes be put in place to ensure industry involvement in programme design and revision.
- Industry professionals be used where appropriate in the delivery of course modules where the main expertise is in industry.
- Industry collaboration be a criterion for funding of HEI programmes.

3. To Develop Structured Postgraduate Programmes

- The development of structured research masters and PhD programmes in biopharma-pharmachem disciplines, that would include taught courses as an integral part of the programme, and a student work placement of at least 6 months.

4. To develop a standardised student work placement for all HEI biopharma-pharmachem related disciplines

- Placements should be of 6-9 months duration.
- A partnership approach between industry, HEIs and students should be encouraged in the provision of work placements
- Placements should be sought in companies in Ireland and abroad
- Subject areas where the main expertise is in industry should be covered during the student work placement. This to include areas such as commercial awareness, business development, communication skills and problem-solving.

To meet and address the recommendations of this report The Departments of Applied Physics and Instrumentation, Biological Sciences and Chemistry have initiated some of the following steps:

1. Embedding of informatics, in particular Bioinformatics into programmes and development of MSc programme in Computational Biology.
2. Greater engagement with Industry in programme development and review through CIT's Industry Liaison Office.
3. Development of a structured PhD programme (Ed4Life), which will provide generic and subject specific modules for research students in the life sciences.
4. Review of the placement element within all of their programmes taking into account the Industry needs and the findings of REAP (Roadmap for Employment-Academic Partnership) work placement report 2011 (attached).

The Department of Computing has faced similar external issues and has initiated some of the following steps, which are addressed in the following section:

From a peak in the late 1990s in the number of CAO mentions from students for places on Department of Computing programmes reaching the 2,000 to 4,000 range, to a change in 2004 to the range 450 to 1000, to a change in 2008 to the 300 to 550 range, mention levels have now stabilised and begun to increase slightly to the 300 to 650 range in 2009 and to 2004 levels in 2010. This pattern is typical of what has been experienced by many HEIs in Ireland in the computing area. A February 2009 report from the Third Level Computing Forum (see relevant attachment) indicates that "numbers studying computing have not recovered from the drop of over 70% in applications for computing degrees in the 2001-2003 period, following the 'dot.com' collapse, though there have been some increases in recent years. A similar situation exists in other countries." The extract from this report, shown below, analyses this situation in more detail and quite accurately describes the general context within which CIT is operating.

- The slowness of the recovery in the numbers reflects various underlying problems.

1. Confidence lost in the 'dot-com collapse' of 2001-2003 has not been regained. "There are no jobs in computing"! The strong employment opportunities are not understood.
2. Computing does not have a clear identity in the community. There is little understanding of what it involves, and a tendency to confuse it with Electronics, Mathematics, or computer manufacturing.
3. The professional career opportunities and general educational value of computing qualifications are not appreciated. There is a fear that such qualifications provide only limited career options.
4. The image of the computing graduate is of the 'nerd' rather than the 'professional'.
5. It is seen as a predominantly male area of interest.
6. Ireland is one of the few Western European countries in which there is no study of computing, as distinct from use of computers, at second level.

- The resulting difficulties for the colleges include

1. Empty places on virtually all full-time computing courses.
2. Very low numbers of women on most computing courses.
3. A decline in the Leaving Certificate grades of computing students.
4. High failure and drop out rates, particularly in first year, where most students encounter programming for the first time. Students are ill prepared to study computing at third level.
5. Difficulty in recruiting Irish graduates to do research.

The issue of "lower entry points" for all programmes is a cause for much concern and generally translates into poorer academic performance and increasing retention difficulties, trends which reinforce the notion that students would be better served by choosing alternative courses of study, which in turn reinforces the negative sentiments towards computing programmes that are widely reported.

Another cause for concern is the fact that institutional behaviour is increasingly rewarded based on a unit cost model. While the strength of this model should be to maximise the return for the tax payer by encouraging the production of high quality graduates for the lowest possible level of investment, its implementation poses a serious risk of contributing to the dismantling of the infrastructure required to provide high quality education in computing by rewarding application-driven volume rather than strategic provision of service.

From the report "Monitoring Ireland's Skills Supply – Trends in Education and Training Outputs" (see relevant attachment), released by the Expert Group on Future Skills Needs in October 2009, it is clear the level of acceptances by CAO applicants of offers of places on computing courses has been rising gradually on a national basis since 2006. This trend would appear to be somewhat at variance with the views expressed in the report issued by the Third Level Computing Forum but acceptance levels are influenced by entry requirements and availability of places as well as by level of demand and herein may lie the source of the apparent discrepancy between the two reports.

Considering Ireland's Higher Education sector more generally, much energy has been expended in recent years on the process of clarifying/redefining its identity and structure in a changing and ever more competitive world. Many questions arise in this context. What is the optimal mode of engagement between the IoTs and the Universities? Should the IoTs focus heavily on teaching/learning and be satisfied with a tactical or minimal presence in research? Should the IoT sector invest heavily in research, fundamental and applied, across all disciplines or in niche areas? Should we focus on lifelong learning to a far greater extent than has been the case in the past? Should we market the sector at home and abroad in a coherent fashion? Should we collaborate extensively as a sector? The publication of the National Strategy for Higher Education Strategy to 2030 has made a number of significant recommendations in this context but, until it becomes clear as to which of these recommendations will be acted upon, decisions re: the final strategy to be adopted will be determined by reference to CIT's strategic plan and local judgement.

The challenging financial circumstances which prevail currently in Ireland and further afield have resulted in many students seeking to undertake additional studies in both full-time and part-time modes. It is likely that this trend will continue for some time as current skills bulletins from the Expert Group on Future Skills Needs indicate that demand for IT personnel is focused primarily on those who have already achieved significant levels of experience, educational attainment and specific qualifications rather than on new graduates. It will be vital that the Institute continues to ensure that options are available to cater for students who wish to maximise their level of educational attainment in order to ensure that any upturn in the economic circumstances of the country may be capitalised upon by a highly educated workforce. It will also be vital to provide conversion and progression pathways for those who wish to move from areas in which employment is no longer available. It is anticipated by many that careers in computing and, more generally, in IT will prove to be more viable in the medium-to-long term than will be the case for many other areas.

The implementation of the Irish Government's Employment Control Framework resulted in a reduction in whole time equivalent academic staff numbers in CIT of approximately 6% over the period 2008-2010. The impact of this reduction on the School's strategic plan will need to be considered very carefully

Issues in relation to the teaching and learning of mathematics at second level are well documented. Low participation rates in the higher level mathematics programme during the senior cycle, high failure rates and limited focus on problem solving have been identified by many commentators as leading to significant problems for students when considering third level programme choices and participating in third level programmes. To address these issues in a far-reaching manner, the Department of Education and Science (DES), in partnership with the National Council for Curriculum and Assessment (NCCA), committed itself as early as 2000 to a fundamental programme of reform, as radical as any ever envisaged since the foundation of the state. As the programme passed from the planning stages to implementation it became known as Project Maths (PM).

Briefly put, the overall aim of PM is to teach mathematics in a way which leads to real understanding. The initiative was piloted in 24 schools across two subject strands in

September 2008 and continued with these same two subject strands being introduced in all post primary schools in September 2010. Further changes relating to the remaining three strands will be phased in over the coming years with the whole process being completely embedded in post-primary provision by 2018.

Because its emphasis breaks with traditional provision, Project Mathematics challenges the Department of Mathematics on two fronts, detailed below.

- The staff of the Department will need to acquaint themselves thoroughly with the content and teaching approach of PM and adjust their first year provision accordingly. This is necessary to ensure that Leaving Certificate students exposed to the context driven approach of PM will be able to make the transition to CIT's first-year Maths programmes in as seamless a manner as possible.
- The Department will need to pursue vigorously efforts, already in train, to provide a post-graduate course/award in Mathematics for Education. The Project Maths Implementation Support Group (PMISG), in its report of June 2010, writes:

The DES will be seeking tenders from higher education providers for the provision of regionally accessible post graduate programmes for teachers of mathematics, focusing on mathematics content knowledge and mathematics pedagogy.

While such a course might be confined initially to the up-skilling of existing secondary school teachers with a 'minor' in mathematics, it could over time be offered to 'other' graduates seeking recognition from the Teaching Council of Ireland as teachers of mathematics. Judging by existing enquiries to the Department, there is a quite a demand for this latter provision.

In addition to the impact of Project Maths, the impact of recent decisions taken in relation to the allocation of CAO bonus points for mathematics remains to be seen.

2.2 The Local Perspective

From a more local perspective, a number of specific factors influence the environment within which CIT operates. These are discussed in the following paragraphs.

University College Cork offers programmes in similar areas on offer at CIT. Programmes include: BSc (Hons) in Computer Science, Biological and Chemical Sciences, Chemistry with Pharmaceutical Compounds, Physics and Applied Mathematics with Physics. While CIT's offerings to school leavers are more applied in nature than is the UCC offering, the availability of an alternative local option for school leavers is a significant factor to be considered. In this context, the effectiveness of CIT's marketing processes is of paramount importance in ensuring that school leavers are fully aware of the high quality of CIT's awards and the high value that industry places on them.

CIT operates a vibrant business incubation centre (The Rubicon Centre) on its Bishopstown campus, which is home to more than 40 startup businesses. This centre provides opportunities for development of students and staff in real-life software development projects, exposure to current business practices and development of knowledge of processes highly relevant to entrepreneurship. Much of the future

economic development of the region is likely to be derived from the activities of Rubicon Centre businesses and the School of Science and Informatics will need to support their activities on a consistent basis.

While it appears that research funding may be reduced somewhat at national level, inter-disciplinary research opportunities are fast emerging in CIT in areas such as biopharmachem and simulation. This is evidenced by recent successes in PRLTIV funding for CREATE (Centre for Advanced therapeutic Engineering) and Ed4Life (structured PhD programmes in the life sciences). It will be important that the School of Science and Informatics takes full advantage of these opportunities when more traditional avenues of development on the research front may become less available than in the past.

2.3 A Brief Review of the Achievements of the School over the last 5 years

Over the last 5 years, the School has succesfully undertaken a series of initiatives to benefit its students and other stakeholders. These are described briefly below.

- As part of the Institute's Modularisation and Semesterisation initiative, the School completely re-engineered its model of curriculum delivery. Across both of its constituent departments, the School developed a comprehensive suite of modules, shared to a very significant extent across cognate programmes.
- The School significantly expanded the range and nature of its portfolio of offerings, as follows:
- New full-time programmes: MSc in Networking & Security, BSc (Hons) in IT Management, BSc (Hons) in Web Development, BSc (Hons) Pharmaceutical Biotechnology, BSc (Hons) Nutrition and Health Science, BSc (Hons) Analytical Chemistry with Quality Assurance and BSc (Hons) Environmental Science and Sustainable Technology, BSc and BSc (Hons) Science common entry.
- New part-time offerings: BSc (Hons) in IT Management, BSc in IT Support, BSc in Computing
- New IT Academy Offerings: CompTIA, Novell, Microsoft, VMware
- New programmes for 2011 intake (in process of academic validation) BSc Hons/ MSc Cloud Computing, MSc Computational Biology and MSc Instrument Engineering.
- The learning accomplishments of a significant number of mature and experienced learners were recognised by the School through CIT's Recognition of Prior Learning (RPL) process (more than 150 RPL applications processed in 2009-2010).
- New methods of delivery, assessment, communication and use of the Blackboard eEducation Platform were widely adopted by staff.
- On the internationalisation front, the School provided leadership to the Institute in forging new links with institutions in India, China and Europe, and providing a solid basis on which to make progress over coming years.
- On the research front, links with departments within CIT and with external institutions such as Darmstadt University of Applied Sciences were strengthened. In addition, research student numbers were increased and research facilities enhanced. An annual conference has been run for the past three years in conjunction with

Darmstadt University of Applied Sciences to provide a forum for students and staff to meet, present their ideas and identify new opportunities.

- Student retention has been prioritised and improvements have been achieved under this heading recent years.
- The Departments of Applied Physics and Instrumentation and Computing developed and delivered four Labour Market Activation programmes in response to the Government-sponsored initiative in this area.
- The Department of Applied Physics and Instrumentation has engaged with the HEA Springboard initiative and proposes to deliver the Higher Certificate in Science in Industrial Measurement and Control and the Certificate in Advanced Industrial Automation programmes.
- The Departments of Applied Physics and Instrumentation together with Departments of Biological Sciences, Chemistry and Biomedical Engineering received funding under PRLTIV for CREATE (Centre for Advanced Therapeutic Engineering), this will fund a research institute to facilitate multidisciplinary research programmes between these departments and external collaborators.
- The Departments of Biological Sciences has expanded it's portfolio in Level 8 courses mentioned above, but also with the Level 8 ab-initio BSc (Hons) Biomedical Sciences and MSc in Biomedical Sciences, both joint awards from CIT and UCC.
- The Department of Biological Sciences received funding under PRTLIV for and Ed4Life (structured PhD programmes in the life sciences)
- The Department of Chemistry has developed the BSc (Hons) Analytical Chemistry with Quality Assurance (ab-initio), BSc and BSc (Hons) Science common entry in an attempt to attract students into the physical sciences. This has been relatively successful when students have seen the increased choices on offer to them.
- The part-time/evening Quality Assurance/Management courses of the department were validated as HETAC Special Purpose Awards in 2006.
- A CIT Special Purpose Award 'Certificate in Quality Assurance' was devised by the department in 2010.
- International collaborations via the ERASMUS scheme were extended to include IUT Grenoble, with additional exchange students coming from there to CIT for the third year of the chemistry programme.
- The Department of Mathematics has provided a new option for Leaving Certificate students who wish to avail of a "second chance" examination for entry to selected programmes in CIT for which a minimum grade in Leaving Certificate Honours mathematics is required.
- The Department of Mathematics has provided significant input to the national Project Maths initiative.
- Programme Boards were activated and module groups were set up to deal with modules independent of programmes.
- Campus Extension initiatives were pursued with on-site delivery of programmes and modules organised for clients on company premises.
- The adjunct faculty option was fully utilised with modules being developed and delivered by industry experts.
- The School contributed to a significant strengthening of the Institute's central IT services while also maintaining current technology in its laboratories and making very significant use of open source technologies.

- The School played a full role in contributing to the Institute being selected as Sunday Times Institute of Technology of the year on two occasions in the last five-year period.

2.4 Themes and proposed actions over the next 5 years.

CIT's mission statement reads as follows:
To provide student-centered education, with a career focus for the benefit of the personal, intellectual and professional development of the student and for the benefit of the whole of society.

CIT's vision statement reads as follows:
CIT will be a pre-eminent provider of career-focused education that embraces diversity and innovation.

With some minor amendment, both statements apply to the School of Science and Informatics and its constituent departments.

The School-specific mission statement reads as follows:
To provide student-centered education, in science and informatics, with a career focus for the benefit of the personal, intellectual and professional development of the student and for the benefit of the whole of society.

The following School-specific vision statement is appropriate in this context:
To be a pre-eminent provider of career-focused education and research, in science and informatics, that embraces diversity and innovation.

The mission statement emphasises the following points:
- A strong focus on the rounded development of the student;
- The applied nature of the programmes, modules and research conducted;
- The close relationship with industry of the School and its constituent departments;
- The need to make a contribution to the whole of society.

The vision statement provides a basis upon which to establish the following objectives:

- Be a pre-eminent provider of national importance, at a minimum, international where feasible, but world class from a regional perspective;
- Ensure that the School's ethos and programme portfolio continue to reflect a career-focused philosophy in terms of delivering practical programmes of study and focusing more on applied research than on fundamental research;
- Focus on physical and life sciences, computing, mathematics, IT more generally, and cross-disciplinary and convergence-based opportunities across all of these areas;
- Embrace diversity and innovation from ordinary degree to PhD, with a niche area research focus, significant engagement with industry across all levels, strong linkages with second level, and a specific focus on entrepreneurship and innovation.

These vision and mission statements are fully consistent with the Institute's strategic plan at the time of writing and with Ireland's Strategy for Science, Technology and

Innovation, 2006 – 2013, which states that "Ireland by 2013 will be internationally renowned for the excellence of its research, and will be to the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture".

While the earlier analysis of the context within which the School is operating identified many challenges, a significant number of opportunities exist for the School to expand its activities. The foremost amongst these are discussed below.

- More opportunities are now available to fund education for those already in employment - the Dept of Computing now has a very high number of part-time students relative to full-time students.
- The research potential of computing staff has been released to an increasing extent by the reduced teaching load associated with managing smaller classes, the establishment of a dedicated Institute Research Office, the co-location of a dedicated computing and mathematics' research space with related research activity, and the enhanced opportunities available as a consequence of increased focus on strategic internationalisation. The research potential of staff in the Department of Mathematics has not been released to the same extent as a consequence of growing class sizes in many areas of the Institute serviced by the Department.
- The Institute-wide adoption of modularisation and semesterisation has provided very significant options with regard to the effective, efficient and flexible operation of the Institute including the rapid development of custom courses through which participants can accumulate credits.
- CIT's leadership position in relation to the Recognition of Prior Learning provides major opportunities to develop and provide custom programmes to individual organisations or clusters of organisations, e.g., EMC has availed of this option very effectively in recent years.
- Innovation-led initiatives such as the Rubicon Centre provide massive opportunities in computing and informatics, given the pervasive nature of the application of technology in new business ventures.
- The opportunities to focus on internationalisation are increasing with the potential to recruit students to targeted programmes from India, China and other areas of demand.
- The provision of a building dedicated to Learning Resources should greatly assist all of the Departments current initiatives in relation to the core issues of student support and student retention. At present, the Learning Support Centre (LSC) operates clinics in Mathematics, Programming, Physics and Electronics. The four subject areas listed share this on a working basis of four hours per week each, on average. Some of the teaching takes places over the summer months to support students repeating semester I and II mathematics modules. The Institute's Self-Evaluation Report notes (p. 60) that:

The effectiveness of the learning support offered by the Centre was supported by an analysis of pass rates carried out in 2006 which showed that, on average, over 90% of students who had attended learning support sessions subsequently passed their examinations.

An opportunity exists to further improve this service by increasing the number of support hours provided, resources permitting.

- The Department of Mathematics will continue to expand on its MathsOnLine programme. This WebCT learning course was initiated as early as 2004 and has been growing ever since both in its content and its capabilities. It provides a vast repository of material on virtually all first-year mathematics and statistics topics. Its designer and over-seer gives an annual presentation to the staff of the Department of Mathematics by way of updating them on its content and enhanced features and also with a view to encouraging staff to promulgate its use amongst first-year students, though its applicability and usefulness is not confined to this particular cohort alone.
- The Blackboard Learning System will become increasingly used by the staff of the school as a repository for lecture notes, exercise sheets and assignments. It also has the potential to be used increasingly by students to submit projects for grading, as a communication area and to reference online external links and resources.
- The Department of Mathematics intends to increase its involvement with the Access Office in the provision of mathematics support for mature learners. To date, it has run a Mature Student Workshop for Learning Support in Introductory Mathematics aimed at easing the passage of such students into first-year science and engineering programmes. A similar such programme was run in January 2011 with the purpose of encouraging mature students to make CAO applications for science and engineering programmes.
- A mechanism concerned with student support in Mathematics is the August Qualifying Examination which qualifies applicants in Mathematics at a variety of levels from a D in Ordinary level to C in Higher level for entry into level 8 engineering programmes. The challenge/opportunity in this context will be to design this examination so that it is faithful to the Project Maths approach.

In summary, the School is operating in a time characterised by very significant challenges and huge opportunities but needs to take some very significant measures to capitalise upon them. The next section of this document sets out the plan of action that the School proposes to pursue to this end.

2.5 Making it Happen

The bulk of the Institute's activities are captured in the process model shown in Figure 2.2 below.

Manage the Institute	Planning	Marketing	Promotion	Delivery	Relationship
This process refers to the management of the Institute as a whole. It covers the work of the Institute Executive but it also covers activities by other individuals and functions in the management of CIT	Plan Institute's Strategy & Activities	Market the Institute	Attract & Admit Learners	Deliver Education	Alumni Relations
			Sell Institute's Services to Clients	Deliver Research	Relations with Industry
				Deliver Services to Clients	Relations with General Public
	Manage Quality				
	Manage Financial				
	Manage HR				
	Manage Communication & Information / IT				
	Manage Facilities				

Figure 2.2: Institute Process Model

This model provides an overview of the interrelated set of processes that combine to manage, market, promote, organise, finance, develop, resource and quality assure the Institute's core activities in alignment with its vision and mission statements. The School of Science and Informatics is involved, to a greater or lesser extent, in all of these activities. It follows that, in order to deliver on its mission and accomplish its stated vision, the School needs to implement a complementary set of targeted initiatives across key processes, taking account of external and internal drivers.

The initiatives that the School plans to take in this context are summarised in Figure 2.3 below.

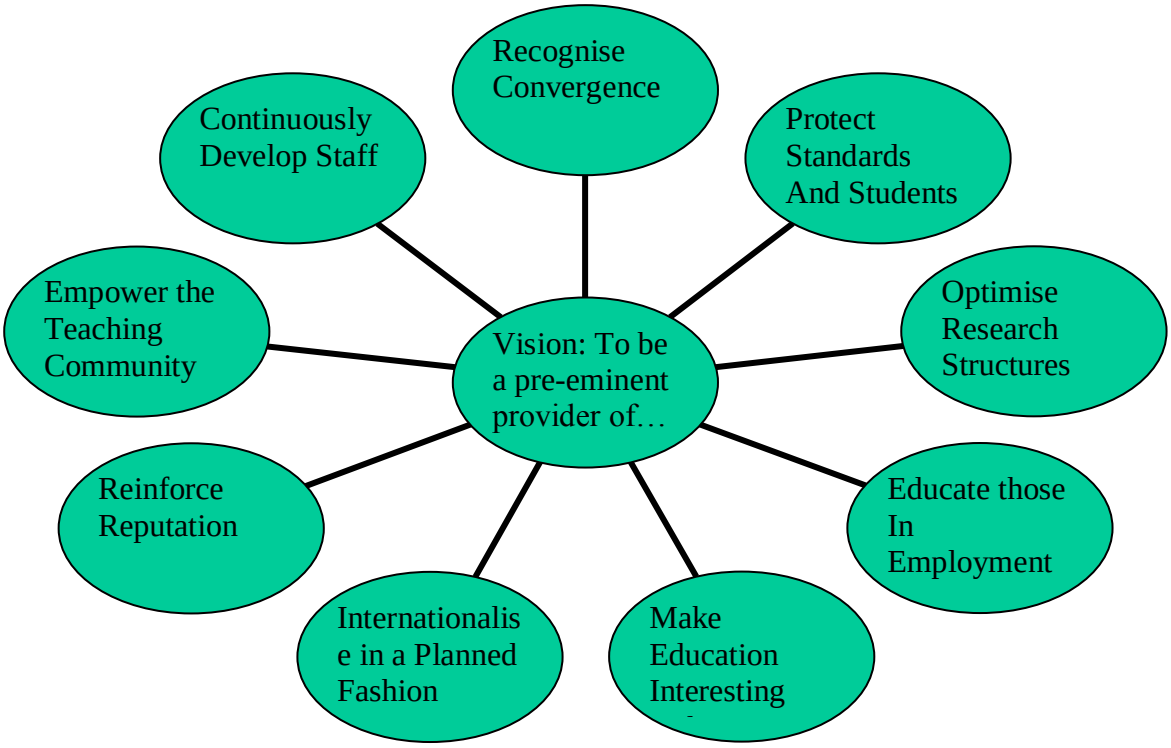

Figure 2.3: Initiatives to be pursued by the School of Science and Informatics

These initiatives are discussed in detail in the following sections.

2.6 Recognise Convergence

The definition of traditional "territory" has blurred considerably in recent years. Recently, (February 2011), the School of Science and the School of Computing and Mathematics have combined to create the School of Science and Informatics. This is a reflection of the convergence of activities in both subject areas and research within and between theses schools. Several departments and research entities in CIT are now operating programmes which incorporate modules and research activities from diverse but aligned areas. While Departments needs to ensure that identity is maintained, collectively they have more to gain from constructive engagement with areas than engaging in competition with them.

In this context, the Department of Computing should seek to collaborate more closely with the following areas:

- Department of Electronics;
- Department of Applied Physics and Instrumentation;
- Department of Media Communications; and
- Department of Accounting and Information Systems

The rationale underpinning this direction is set out below.

- A very significant degree of convergence is developing across the areas of focus of these departments.
- Teaching and research across these departments is already taking place in many areas of shared interest such as software development, real-time software, networking, communications, simulation, gaming and social media.
- Complementary sets of programmes are being developed across these departments.
- Students and staff engage with the programmes of these departments in a flexible manner, e.g., students of the Department of Applied Physics and Instrumentation transfer to the Department of Computing at undergraduate level, Computing students provide feedstock for Electronics research, staff from these departments teach on each others courses, complementarity exists between the BBus in Business Information Systems and a number of Computing programmes etc.
- With the relatively recent introduction of Modularisation and Semesterisation in CIT, some overlaps between the activities of these departments have becoming increasingly evident and, in some cases, have generated portfolios of modules which could now be addressed.

Similarly and for the same rationale the Department of Chemistry should seek to collaborate more closely with the following areas:

- Department of Biological Sciences;
- Department of Chemical and Process Engineering

This will facilitate the promotion of a 'joined-up' approach of the Pharmaceutical Sciences to students and Industry; it will also 'dove-tail' into the BiopharmaChem Expert groups recommendations (as detailed in Section 2.1; The National and International Perspective, page 22 of this report)

The School's strategy will be to recognise this convergence to:

- Provide end-to-end development of programme and research offerings e.g. in networking, telecommunications, pharmaceutical sciences and informatics covering everything from professional education to postdoctoral research;
- Eliminate overlaps in provision and increase efficiency;
- Exploit synergies in the context of modularisation for the overall benefit of the Institute;
- Provide enhanced opportunities for staff development e.g. some current Electronics postdoctoral researchers with computing backgrounds have the potential to become computing principal investigators, the development of the Bioinformatics Research Group with inputs from staff from the Departments of Computing and Biological Sciences.

If this can be done successfully then opportunities will be generated to:

- Create a more student-centred approach in terms of choice and quality of educational experience;
- Recruit a higher proportion of research active staff and/or develop the research interests of current staff members;

- Create dedicated roles in promotion to recruit full-time students, attract fourth level researchers, engage with industry and expand internationalisation activities;
- Over time, provide the opportunity to build new research activity not currently in place e.g. further develop the Informatics Group;
- Eliminate local rivalries for the overall benefit of the Institute e.g. tackle module proliferation issues;
- Address deficits in administrative and technical support by pooling of support in these areas and by freeing up funding to recruit/fund services at required levels;
- Increase utilisation of resources - human, financial and space;
- Create increased opportunities for succession planning

The successful undertaking of this initiative will require significant Institutional leadership and collegiality. The chances of achieving this will be enhanced as a consequence of the recent merging of the Faculties of Engineering and Science respectively into the single Faculty of Engineering and Science and the new School of Science and Informatics.

2.7 Protect Standards and Students

Although not always the case, it will be accepted by many that the level of CAO points achieved by students in their Leaving Certificate examination provides an early indicator of the chances of these students succeeding in their studies in Higher Education. Clearly, student commitment, maturity and other factors will be very relevant in this context also.

To date, CIT has enrolled students based largely on the CAO quota-based system. In the School, this approach has contributed to the development of significant retention challenges at a time of relatively low (though recovering) levels of applications. In addition, this situation has the potential to discourage potential recruits, disappoint employers and consume capacity (human, space, financial) which could be used more beneficially elsewhere in the Institute.

Therefore, the Departments should adopt a minimum entry standard rather than a quota-based approach for filling programmes. The adoption of this approach:
Should increase retention performance significantly, a strategic objective of the Institute;

- Should improve the student “experience” in all of our programmes;
- Will result in programme differentiation and reputation enhancement;
- Ultimately, has the potential to provide a higher number of graduates who may wish to progress to research careers, a strategic national objective;
- As the School improves its “educational process capability”, it should continuously revisit the minimum entry standards to ensure that it strikes a fair balance between providing access to programmes and student success.

The Department of Mathematics are developing a Technological Maths module that is relevant to the needs of the students of the School and will be a mandatory module undertaken by all Year 1 students enrolled on our programmes.

In addition, the School should continuously focus on the retention of admitted students using every means possible and, specifically, taking advantage of the complementary proposals set out in this document.

2.8 Optimise Research Structures

The Institute has relatively recently created full-time posts for a Head of Research and a Dean of Graduate Studies. The School of Science and Informatics will engage fully with all initiatives of this nature to:

- Establish an improved support structure for staff interested in research;
- Create critical mass in research areas in a way which cannot be achieved within a single school or department;
- Foster development of emerging areas such as bioinformatics;
- Exploit linkages with the Genesis Programme, the Rubicon Innovation Centre, centres of excellence in Ireland and elsewhere, other third level institutions, as well as with industry;
- House credit-bearing common research-orientated modules as well as entrepreneurship modules;
- Position us to compete for funding and engage with other IoTs and Universities from a position of greater strength and organisation;
- Provide more focus on professional, work-based/research-based opportunities at Masters' and PhD levels, with the ambition of embedding research staff and activity in innovation-based businesses (marrying research with innovation and entrepreneurship);
- Ultimately, facilitate and professionalise the training of research students across the Graduate School, monitor and manage student progress on a uniform basis, improve the quality of research training provision, promote research excellence and increase research volume by increasing research student numbers, and generally championing graduate education;
- Participate as a full member of the Institute's Innovation Ecosystem, contributing to Institute performance in technology transfer and commercialisation activity.

2.9 Educate Those in Employment and Those Seeking Employment

It is a clear national priority to pursue this goal. The attainment of higher educational qualifications by those in employment will help secure jobs and contribute to the development of Ireland's knowledge society. The provision of options for those seeking employment will help create a pool of talent in areas in which demand is likely to rise more rapidly than will be the case in other areas of the economy. The points set out below are relevant in this context.

- 80% of the current workforce will still be in the labour force in 20 years time.
- A high proportion of members of Ireland's current workforce have a relatively low level of educational attainment.

- Major opportunities remain available to CIT in this context as evidenced by the high number of Dept of Computing part-time students relative to the number of full-time students.
- Successful running of the Labour force activation programmes in Departments of Applied Physics and Instrumentation and Computing indicates our appetite for this.
- The Department of Applied Physics and Instrumentation has engaged with the HEA Springboard initiative and proposes to deliver the Higher Certificate in Science in Industrial Measurement and Control and the Certificate in Advanced Industrial Automation programmes.

In order to undertake successfully this initiative, the School of Science and Informatics will need to:

- Invest in eClassroom technology, especially in areas where online laboratory work feasible e.g. virtual networking laboratories;
- Market its offerings continuously and professionally to those in employment and to the unemployed;
- Free up capacity as per the recommendation re: recognition of convergence.

2.10 Make Education Interesting and Accessible

Many would consider that the traditional mindset in relation to education more or less translates to "we will provide the education; it is up to the students to turn up and avail of what we offer." There is less than universal acceptance of the notion that there is a need to maximise the attractiveness of the learning experience as well as its effectiveness. The School of Science and Informatics has been quite innovative in this context but has the potential to achieve more. Current examples that reflect the required approach include those described below.

More continuous than terminal assessment has been implemented in many science and informatics modules, where appropriate.
Visual/game-based software development environments have been used in the earlier stages of computing programmes.
A programme independent module (PIM) in Mathematical Explorations, which acquaints the student with the heuristics and joy of discovering mathematical results for oneself, has been developed and offered. Throughout this non-standard module, the student is actively involved in self-learning whereby (s) he acquires non-trivial mathematical knowledge along with a clear understanding of the notion of mathematical proof.

The School needs to engage consistently and strongly with the Educational Development Unit to obtain training, advice and guidance in this context, as well as leveraging the relevant research interests of its own staff while taking full advantage of the small class sizes and closeness of staff to students in the Institute of Technology environment.

2.11 Internationalise in a Planned Fashion

Building on previous recommendations, international students are more likely to be attracted to a faculty with well-defined research focus, allied to opportunities to work with industry. Clearly, it is in Ireland's interest to attract high quality foreign students who can become embedded in local/regional industry, in keeping with our overall mission/vision.

However, in keeping with the standards-based philosophy set out in earlier recommendations, we need to pick our targets carefully. Initially, we should seek to attract postgraduate and postdoctoral researchers to boost the capacity of our core research areas by developing relationships with selected third level institutes, e.g., University of Pune in India. Thereafter, depending on the outcome of initial efforts, we should consider seeking to attract undergraduate students also, if the levels of pastoral care required are not prohibitive. Modularisation provides significant options in this regard.

The success of initial efforts in this context has been mixed. The practical skills of international students have been of a lower level than that anticipated by CIT and some difficulties have emerged in this context. We are learning from these issues and putting measures in place to achieve better outcomes for international students and the staff with whom they engage in CIT.

It is vital to strike a balance between the level of investment involved and the positive outcomes achieved. With recent improvements in the physical quality of the Bishopstown campus, it should be easier to justify investing in a more comprehensive marketing campaign than has been pursued to date.

2.12 Reinforce Reputation

Over a significant number of years, the School of Science and Informatics has made a significant contribution, both locally and nationally, in terms of producing well-qualified graduates, engaging with industry, supporting state development agencies in attracting foreign direct investment to the region, providing teacher education at Masters' level and making its facilities available, where appropriate, to third parties concerned with regional development. A significant number of industry leaders have graduated from the School.

In a time of ever-increasing competition for students, it is important that the School ensures that its reputation is reinforced and key messages re: its strength and relevance communicated to students (prospective and current), graduates, schools, key national decision-makers, industry leaders and other stakeholders.

To this end, the School needs to undertake the initiatives described below.

- Continue to play a prominent part in key representative groups, such as:
  - PharmaChem Industry Board

  - Membership of key educational committees of relevant professional bodies including: Academy of Medical Laboratory Science, Institute of Physics, Royal Chemical Society
  - it@cork, the regional IT association which represents 280 corporate members;
  - the Third Level Computing Forum; and
  - the National Council for Curriculum and Assessment's Mathematics Board.
- Develop contemporary, efficient and effective processes to communicate key messages re: School reputation and offerings to its wide range of stakeholders
- Ensure that a broad and consistent awareness of the high quality of the School's offerings, facilities and staff is achieved

2.13 Empower the Teaching Community

The School has made a consistent contribution to the development of computing expertise in the primary and secondary level teaching communities through its Postgraduate Diploma in Computing in Education and related MSc in Computing in Education programmes. These programmes ran successfully for a number of years and produced a significant number of graduates. More recently, demand for these programmes has reduced and they have not been operated for a period of two years. Nonetheless, it is imperative that teachers at primary and secondary levels be supported in gaining knowledge in relation to computing and the School should make every effort to contribute in this context.

One possibility is that the Institute dramatically increase the depth and quality of its relationships with primary and second levels by introducing a suite of education-based MSc offerings. The points set out below would be relevant in this context.

- Use discipline-specific modules in conjunction with shared modules in pedagogy and educational aspects e.g. with the MSc in Computing and Education, MSc Science and Education and other potential programmes
- Leverage other recommendations made in this document – eClassroom, credit-based reward for lecturers, use research modules from the Graduate School, accommodate work-based research etc.
- Focus on teachers not qualified to MSc level as attainment of this level of qualification would enhance their career prospects and earning potential

While the MSc in Computing in Education has not run in the last two years, it may be feasible to create critical mass of interest in a suite of related MSc programmes aimed at the second level and primary level teaching communities which could be run in a viable manner if designed to accommodate a significant number of shared modules.

As indicated in section 2.1, the most immediate way in which the Department of Mathematics could empower the second level teaching community would be through the provision of a post-graduate programme in Mathematics Education aimed at the constituency of secondary school teachers seeking to upskill themselves along lines which would gel with the Project Maths initiative.

It may be feasible for CIT and UCC to run such a programme jointly. Alternatively, it may be feasible for CIT to operate such a programme in conjunction with other Institutes of Technology.

2.14 Continuously Develop Staff

Staff in the School face a continuously changing environment in which they need to deal with a myriad of challenges, including the following:

- Dealing with the learning needs of a wide spectrum of learners
- Changes arising as a consequence of the recently implemented modularised system of education in CIT
- Changing pedagogical and technological approaches in higher education

The School supports staff development in the following ways:

- Through in-house courses offered by the Institute's Teaching and Learning Unit (TLU)
- Through third and fourth level programmes supported by the Registrar's Office
- Through participation in short, specialist courses funded by the School
- Through purchase of books and learning materials by the School as required by individual members of staff
- Through participation in relevant conferences, seminars and colloquia, funded by the School
- Through in-house briefings offered by School and Institute staff on a voluntary basis

The School will continue to support the development of staff as described above and, in addition, will seek to implement specific staff development measures to support the initiatives described in this document.

2.15 Conclusion

The School's ability to succeed in the future will hinge on the extent to which it can deal with a rapidly changing environment, continuously innovate, anticipate new and emerging requirements, and deal with financial challenges generated as a consequence of the national economic situation. It has made significant progress in recent years in a number of key strategic areas. Demand for its offerings should grow over coming years as it implements a strategy which is centred on addressing student needs in an effective, efficient and flexible manner. It is well placed to address these anticipated challenges.

3 Prospective student perceptions, Including marketing & promotion activities, public information, links with schools etc.

The School of Science and Informatics actively engages with local and regional schools and networks through various strategies, these include:

- Active engagement with the Schools Liaison Office to promote courses and answer questions from teachers and careers advisers
- In 2010 there was a Faculty-wide leaflet drop to over 200,000 homes in the Cork area to promote and advertise new course provision.
- Establishment of formal links with schools in Cork City and County through the access initiative allowing entry of level 5 FETAC students onto selected courses within the School.
- Regular participation in invited Schools open days and visits
- Attendance at Careers events, "Higher Options" fairs, and contacts with guidance counsellors through the 'guidance counsellors' day at CIT.
- Attendance at CIT open days
- Hosting of the Scifest event in 2008, 2009, 2010
- Active participation in the Science4Life programme for disadvantaged schools in Cork City
- Participation in the NOWTASTER programme
- Engagement with transition year students on work placements in science laboratories
- Organising School of Science and Informatics Revision sessions in Biology, Chemistry, Physics for leaving certificate students
- Involvement with the Cork Schools Science Awards
- Surveying of existing and past students (attachment 18)

4 Facilities

A detailed listing of all of the School's classrooms, laboratories and computer/IT facilities is listed in Section 11. A number of issues have arisen since the last review with respect to adequacy of facilities and future needs, they are listed below:

With the advent of Modularisation and Semesterisation in CIT a number of modules are shared across various programmes within the School, for example Mathematics, Chemistry, Physics and Biology modules across year 1 programmes. This has resulted in larger class sizes while attempting to reduce the instances of delivery. This has placed a heavy burden on teaching facilities especially in the provision for laboratory delivery. This is most notable in the Department of Biological Sciences which has seen a rise in enrollment over the last 5 years. This 'bottleneck' may be somewhat reduced by the Croke Park Deal which may allow the timetabling of classes and laboratories after the current 6pm deadline

The success of the research activities within the School over the last number of years has seen an increase in funding and correspondingly in numbers of postgraduate research students. This also places a heavy burden on the research facilities of the School. The successful CREATE PRTLIV application will result in the provision of an 1800 sq ft research building for researchers within Departments of Applied Physics and instrumentation, Biological Sciences and Chemistry. Subsequently the space freed up by movement of research students into this area will be used for undergraduate laboratory/teaching activities. This building will be completed by the end of 2014.

5 Staff Development

The School of Science and Informatics seeks to facilitate the career and personal development of its staff through the active engagement in staff development activities. Outlined below are the activities undertaken by staff from 2005-2010.

Departments of Applied Physics and Instrumentation, Biological Sciences; and Chemistry Activities 2005-2010

Teaching and Learning Unit
The establishment of the Teaching & Learning Unit (TLU) by CIT in September 2008 formalised staff development, which is regarded as an essential element in realising the Institute's commitment to continuous improvement in quality. Membership of the TLU is drawn from each Faculty within the Institute with additional members bringing expertise in areas of e-learning and teaching with technology. Activities are varied but primarily revolve around workshops and courses provided to staff in areas such as instructional and curriculum design, assessment, problem-based learning, and technology-enhanced learning. The following is a list of workshops which are currently organised by the TLU:

- Evaluating Pedagogical Practice
- Recognition of Prior Learning
- Portfolio Assessment
- Google Apps
- Plagiarism
- Blackboard
- Multiple Choice Questions
- Formative Assessment
- Research Design
- Learning in Groups

The TLU is research active, with new teaching and learning approaches and methodologies constantly being piloted and, as appropriate, mainstreamed in the Institute. Located within the Office of the Registrar and VP for Academic Affairs, the TLU supports the work of the Registrar in a wide range of quality enhancement initiatives. These initiatives range from developing effective teaching and learning environments, developing and disseminating Institute policies on teaching, learning and assessment and supporting the design of modules and programmes.

Staff Development 2005-2010:
Historically, staff development at CIT was organised under the following eight strands:

1. Short Course Strand (Internal)
Activities in this area are primarily organised in-house and are now delivered in the main by the TLU, although individual departments or units may contract a specialist course in, e.g. first-aid or fire safety. Courses, workshops and seminars are designed to meet specific identified staff development needs, as demonstrated by the list above.

Depending on the nature of the requirements, these may be offered to a particular department or may be interdepartmental.

This strand has been widely used by School of Science staff, as is illustrated in the following table.

Science

Course Title	Name	
Technology Supported Learning Part 1 Technology Supported Learning Part 1 Overview of Blackboard LMS Adobe Acrobat Professional Microsoft Advanced Outlook	Eamonn	Cashell

Table 5.1

Department of Biological Sciences

Strategies to Foster Academic Honesty	Michael	Healy
Blackboard for New Users Strategies to Foster Academic Honesty	Lesley	Cotter
Strategies to Foster Academic Honesty Mahara - Using E-portfolios Blackboard for New Users	Anna-Maria	Keaveney
Making Teaching Work Masterclass Blackboard for New Users	Margaret	Lane
Blackboard for New Users	Bridget	Lucey
NAIRTL Grant Initiative Seminar Blackboard for New Users	Hugh	McGlynn
Recognition of Prior Learning - Policies & Procedures Blackboard for New Users	Anna	Murphy
Overview of Blackboard LMS Blackboard for New Users	Helen	O'Shea
GoogleApps - Technology to Support & Assess Teamwork Bringing Active Learning to the Classroom Making Teaching Work Masterclass NAIRTL Grant Initiative Seminar Mahara - Using E-portfolios	Siobhan	O'Sullivan
NAIRTL Grant Initiative Seminar	Roy	Sleator

Table 5.2

Department of Chemistry

Strategies to Foster Academic Honesty	Ambrose	Furey
Introduction to PBL Strategies to Foster Academic Honesty	Mary M.	McCarthy
Making Teaching Work Masterclass Blackboard for New Users	Maryanne	Sheehan

Table 5.3

Department of Applied Physics & Instrumentation

Strategies to Foster Academic Honesty Blackboard for New Users Copyright, Creative Commons and Open Education Resources	Eleanor	Baldwin
Making Teaching Work Masterclass Blackboard for New Users	Eamonn	Butler
Introduction to PBL Making Teaching Work Masterclass Formative Assessment	Carmel	Devaney
Recognition of Prior Learning - Policies & Procedures Making Teaching Work Masterclass NAIRTL Grant Initiative Seminar Configuring Blackboard for Module Delivery Research Design - Qualitative & Quantitative Methods Mahara - Using E-portfolios Managing Assignments in Blackboard Digital Images for Blackboard	Catherine	Frehill
Strategies to Foster Academic Honesty Portfolio Assessment Configuring Blackboard for Module Delivery	Harvey	Makin
Strategies to Foster Creative Thinking Problem Based Learning (3of5) Problem Based Learning (5of5) Technology Supported Learning Part 1 Portfolio Assessment Configuring Blackboard for Module Delivery	Liam	McDonnell
Cognitive Information Processing - Design of Effective Lectures	Eva	Norris
Overview of Blackboard LMS	Martin	Woods

Table 5.4

2. Seminars, Conferences and External Short Courses

Each Department/School is allocated funding under the block grant for staff development and this is applied by the Head of Department/School to staff within their own areas. Generally, it is used for conferences, seminars and external courses. The

overall spend on these events across the School of Science between 2005 and September 2010, including income received from research contracts, is summarised in the following table and chart:

The following chart shows the average expenditure on staff development per WTE staff member per year over the period 2005 – 2010:

Figure 5.1

Examples of events attended include:

- Photonics Europe Strasbourg
- SCADA Training Course
- ISPM Conference Jeju South Korea
- PAQ 07 Conference Royal Society London
- Workshop On Imaging London Institute Of Physics
- Vacuum Technology Seminar Birmingham
- Institute Of Physics Ireland Spring Weekend Conference
- Research Visit Whipple Obs. Arizona
- Is Physics Any Of Your Business Conference
- Laser Optics Conference
- Cleo Conference - San Jose USA
- EMCO Workshop Dubrovnik
- Bionet Conference Dublin
- AMLS Conference Carlow
- SGM Conference University Of Limerick
- Bacteriophages Conference London
- ESM Conference Plovdiv Bulgaria
- Edinburgh International Phage Conference
- Rotavirus Workshop UCD
- INTED Conference - Valencia
- BMSS Conference Scotland
- Pesticide Residues In Food Germany
- American Chemical Society Conference. San Francisco
- Chem-Bio Seminar/Training Dublin
- Environmental Conference Dundalk
- American Chemical Society Conference ,
- Conf. And Workshop Denver, Colorado

- Super Critical Fluid Training New York
- Botanical Conference India
- IMSS Conference Bremen, Germany

3. Information Technology Training

The Institute identified the need for on-going training of staff in Information Technology and has allocated staff and physical resources for this purpose. A full-time trainer was allocated to staff training and a purpose-built IT training suite provided. This has been operational since late 2000. The service operates through direct provision of courses, supported self-learning using both learner packs and web-based learning. Support is also provided on an individual basis to staff members. Staff who participate are drawn from academic, administrative and technical grades. A sample of the courses offered includes:

- Microsoft Outlook;
- Adobe Acrobat Professional;
- Blackboard

4. CIT Course Strand

Approximately one hundred and fifty evening courses are run by the Institute and staff participation in these in encouraged and supported. The courses operate on a self-financing basis and fees for CIT staff are provided by a transfer from staff-development funding. Members of staff avail of this support with involvement of academic, administrative, technical and support staff in the programmes.

5. Management Training

Delivery of management training programmes commenced during 2006, with the following courses on offer:

Course	Duration (Days)	School of Science Participation
Essential Management Skills	2	
Leadership Skills	1	E. Cashell
Time Management	1	E. Cashell
Leading and Managing Staff	0.5	L. McDonnell
Conflict Resolution	1	L. McDonnell
PMDS - Management Skills	2	L. McDonnell
Public Relations Briefing	0.25	E. Cashell; L. McDonnell
Personal Development Day	1	E. Cashell
Effective Leadership Practices	1	
Bullying & Harassment	1	
Management - Finance	0.25	E. Cashell; J. Wood
Advanced Outlook Training	0.33	E. Cashell

Table 5.5

6. Advanced Qualifications Strand

This funding provides for the payment of fees for staff members pursuing courses in other higher education institutions, mainly masters or doctoral programmes. One staff

member from the School of Science has received funding under this strand to pursue a PhD research programmes in UCC.

In addition, the following two highly beneficial staff development strands that were funded under the EU's "Training of Trainers" programme and managed by the Institutes of Technology Ireland (IOTI) organisation were discontinued in recent years:

7. Higher Education Staff Development (HESDN) Masters Strand

Under this strand, staff members participated in masters programmes operated in conjunction with other Institutes of Technology. The disciplines covered included: Computing, Management in Education, Multimedia, Enterprise & Technology, Advanced Engineering Technology and Advanced Scientific Instrumentation (MAST), which was managed by the School of Science at CIT.

The programmes operated on a modular basis and staff members could opt to pursue a full programme or a number of modules.

8. HESDN – Primary Degree Strand

As with the other HESDN strand above, the programme operated in conjunction with other Institutes of Technology (and UCC). Cork Institute of Technology had overall responsibility for the organisation and operation of the course, which had approximately sixty participants. The programme was aimed at craft teachers who wished to upgrade their skills and qualifications.

Staff Induction

The Human Resources Office operates an induction programme for new academic and administrative staff. The main elements of the programme are as follows:

- Overview of Institute structure, objectives and mission
- Functions within the Institute (Academic Departments, Registrar's Office, Finance/
- Administration, Development Office)
- HR issues
- Role of the Lecturer

Department of Computing Activities 2005 -2010

The past five years have seen very significant changes to how the Institute carries out its business. The changes affected every member of staff so training and support had to be universal if the changes were to be achieved with any degree of success. At the same time staff needed to be aware that their own specialist discipline had to be kept current. The following review of staff development for the period is divided into internal covering the universal changes and external which relates to the discipline specific material.

1. Internal

In the period under review, the major challenge that faced staff was the Modularisation & Semesterisation (M & S) project. While the first modules were delivered in

September 2007, the actual change process had to start much earlier. The change to an M & S format was the single greatest change that any of the academic staff would have experienced since joining CIT.

The major focus on staff development, training and support from 2005 to 2008 was on this transition. The focus in programme development had to change from content focused to Learning Outcome focus. All staff needed assistance if this change was to be achieved successfully. Much of the training came from the Educational Development Unit, the fore runner of the current Teaching & learning Unit. Staff seconded to the EDU and some external experts delivered courses/seminars on:

The National Qualifications Framework with emphasis on levels 6 to 10;

- Writing learning outcomes at programme level and module level
- Writing a module and using the new web based tool to manage the task
- Delivery methods, including blended learning
- Approaches to assessment and providing student feedback

The significance of these short sessions, delivered to a large group of academics cannot be overstated. The sessions led to on-going discussions, sometimes seeking help or clarification from the EDU, on the topics and how they could be utilised in redesigning programmes and creating new modules.

The period saw the longest, most intense and sustained debate on teaching and learning within the Institute for very many years. The focus on the actual delivery, assessment and student experience has helped to bring those areas into centre stage. The debate is still on-going, a significant measure of success, and the objective is to have it continue and to be seen as an area for self-development.
Almost all staff within the Department have attended training sessions on an eLearning Management platform, originally WebCT and now Blackboard. Many staff members currently use Blackboard as the interface to the student body, uploading module notes, assignments and for some organising MCQ.
Continuing in the teaching & learning theme the Department organised 3 seminars in May 2010. One session was on Web2.0 technologies and how these can be used in delivery. The seminar was delivered by Mr. Tim Horgan from the Department who has experience in just such use of the technology. Mr. Gary Couse and Mr. Colin Manning also Department staff delivered a seminar to colleagues on creating web pages. This was intended for staff whose core discipline is in hardware or Computer Science and who wishes to create a better web presence. This is planned to be first in a series of such seminars.

For the final seminar an outside presenter from IT Tallaght was invited to lead a discussion on how to implement project based learning. The seminar was targeted at programming lecturers in particular and is an initiative to attempt to improve retention. This was followed by further internal discussion and has resulted in a pilot project being run with all first year students this academic year.

2. External

Local organisations:

CIT is an active member of IT@cork and avails of opportunities that the membership provides. Staff members, usually six or more, attend the annual conference in November. Outside of the conference the major area of interest is in the technical stream. These sessions would have focused on development environments in particular, e.g. Java, Extreme Programming. Besides the technical content, the interactions provided opportunities to meet practitioners and to discuss current practice and possible future directions.

Professional Academies:
The Department operates a number of professional academies, viz CISCO, CompTIA and VMware. These academies operate on a self-financing basis and are required to make a small profit. The profit is then used to maintain current the staff qualifications in the area. The knowledge and skills acquired are used across all programmes.

The academies also provide a mechanism to up-skill or re-skill staff members both within and without the Department. In 2009 -2010 two staff members were re-skilled via the CISCO academy so that they could be assigned to networking based modules. The newly established VMware academy will be availed of to up-skill some staff members in the area of virtualisation. This is an area of growing importance to industry and will be a fundamental pillar in building the new proposed offerings in "Cloud Computing".

Conferences:
Staff members are encouraged and supported to attend conferences of relevance to their work. Some of the conferences that were attended were:

- ITT Conference , CIT 2005;
- 5th Teaching and Learning Conference
- ITT Conference, GMIT 2008
- SIAM UDIE Conference, Southampton 2008,
- CISCO Networkers Conference, Barcelona 2008
- VMWorld Conference, Las Vegas 2008
- CISCO Live conference, San Francisco 2009
- GECCO Conference, Canada 2009
- Eurographics Conference, Dublin 2010
- IEEE Congress, Barcelona 2010

Courses:

- UML
- Technical Aspects of GPS
- Time Management (HoD)
- RFID
- MYSQL for DBA's
- .net Platform
- Oracle SQL performance
- Development Frameworks
- iPhone development programme
- SARS Course (number of) - new security area

Security is currently seen as a priority area within the Department for development.

Advanced Awards:
The Department encourages its staff to undertake further study to achieve higher level degrees. A number of staff members have availed of the funding, provided via the Registrar's Office, to complete M.Sc. courses. Currently one member of staff is being supported in studying for a PhD.

6 Industry Links

The School of Science and Informatics actively engages with local and regional Industry through the following strategies:

Placements
Within the School there is dedicated Staff engagement with Industry through Industry Placements. Each student undertakes a placement (14 week minimum duration) in semester 6 of their programme. In advance of placement, Industry staff deliver lectures to students. This affords students with CV writing and interview skills and also an insight into placement activities. Within each programme dedicated placement coordinators liaise with Industry to organize interviews, select and prepare students. The coordinators visit the student in their 'workplace' during the placement.

The School has been actively involved in the REAP initiative 'Work Placement in Third Level Programmes', providing the Institute, Student and Employer with standardised guidelines for placement activities. This takes the form of work-booklets and procedures, pre-, during and post-placement. Industry are also invited into the Institute to give feedback on placement activities and inform the course team of any improvements to the placement module.

Participation in Academia -Industry Initiatives
School staff are actively engaged with Industry through initiatives such as participation in it@cork, involvement in the PharmaChem Industry Board and the Expert Group Future skills Needs – Biopharmachem. The interaction has to work in both directions and to engage Industry more constructively the development of Adjunct Faculty positions for suitably qualified industry individuals has been considered, approved at institute level and will roll out in the School in the coming academic year.

On the Research front, the School has actively pursuing engagement with Industry through Innovation Partnerships and Vouchers, facilitated via the Industry Liaison Office. Staff within the School have participated in 10 Innovation vouchers, totaling €50,000 since 2005.

New Course Development
When developing any new course or programme, engagement with the appropriate Industry individuals for marketing and curriculum development purposes is a mandatory requirement. Recent examples of this include the involvement of:

- EMC on the development of the BSc (Hons) and MSc in Cloud Computing
- Pfizer, Schering Plough, Centocoor on the development of BSc Hons Pharmaceutical Biotechnology and MSc in Computational Biology
- Glanbia, C&C Ireland Ltd, PepsiCo on the development of the BSc Hons Nutrition and Health Science
- Eli Lilly, Merck on the development of the Ed4Life programme (structured PhD programme in the Life Sciences), to better understand Industry's needs for postgraduate students

7 Research

The main Institute research activity is primarily (though not exclusively) organised around three Strategic Research Clusters that reflect the CIT current dominant strategic research strengths and critical mass. The areas of research conducted within the School fall within three key areas: Bio-Explore, Photonics and Computing.

The numbers of research active staff (as defined as having current research grants or research students or publishing or filing invention disclosures) across the School are as follows:

Department	**No of research Active Staff**
Applied Physics & Instrumentation	4
Biological Sciences	7
Chemistry	2
Computing	3
Mathematics	3

Table 7.1

1. Bio-Explore

Bio-Explore includes researchers from the Departments of Biological Sciences and Chemistry. Their main focus is the identification and chemical characterisation of biological toxins and the development of novel bio-therapeutics, and specifically the identification, isolation, expression and engineering of pharmacologically active agents from microbial and other sources for the development of novel infection control agents and improved vaccine and/or drug delivery platforms. Specifically, Bio-Explore researchers will develop their peptide engineering expertise with a view to producing therapeutic bio-actives. Since 2005, Bio-Explore researchers have graduated approximately 2 MSc and 12 PhD students and currently have 10 MSc and 10 PhD students on the register.

Source of Funding	2006	2007	2008	2009	2010	2011	Total
Govt.Dept./ Research Funding Agency (including PRTLI)	3,009000	740000	232700	215000	3,971000	140000	8,307,700
EU Funding	0	0	0	200000	125000	0	325,000
Industry/Enterprise	0	50000	0	0	0	102000	152,000
Foundation/ Philanthropic	0	50000	0	0	0	0	50,000

Table 7.2

2. Photonics Device Dynamics Research

The Photonic Device Dynamics Group was created in September 2006 when Dr. Guillaume Huyet joined the Department of Applied Physics and Instrumentation. The group emerged from the Optoelectronics & Non-Linear Dynamics group of University

College Cork, but remains a member of the Tyndall National Institute. The group is based in the Institute's facilities at the Lee Maltings complex. The group's research aims to advance the understanding of the dynamics of novel semiconductor materials and devices from both applied and fundamental viewpoints. Current areas of interest include the properties of quantum dot systems (InAs and GaSb dots) and optical feedback and injection in semiconductor devices. Since 2005, Bio-Explore researchers have graduated approximately 2 MSc and 1 PhD students and currently have 2 MSc and 5 PhD students on the register. The Department of Applied Physics and Instrumentation has in total graduated 10 MSc and 5 PhD students since 2005.

Source of Funding	2006	2007	2008	2009	2010	2011	Total
Govt.Dept./Research Funding Agency (including PRTLI)	330000	3,844000	1,861000	570000	467000	96000	6,598,000
EU Funding	40000	212000	0	0	828000	370000	1,450,000
Industry/ Enterprise	0	0	61000	44000	50000	19000	174,000
Foundation/ Philanthropic	0	0	0	0	0	0	0

Table 7.3

The School of Science and Informatics actively engages in industry related, multidisciplinary research activities. A measure of this activity was the CREATE Proposal which was funded by PRTLIV in July 2010.

Multidisciplinary Research and the CREATE Proposal

The Departments of Applied Physics and Instrumentation, Biological Sciences and Chemistry, together with the Department of Biomedical Engineering formed the CREATE team in 2009. CREATE successfully received €3.5 million for a research building and €350,000 for a structured PhD programme in the Life Sciences through PRTLIV.

The purpose of CREATE was to assemble a multidisciplinary collaborative research team combining the three existing areas of biosciences (Bio-Explore), biomedical technologies (MEDIC) and advanced bio-imaging (CAPPA) to drive research in Advanced Therapeutic Engineering. CREATE is an important regional research and innovation facility, and is specifically identified in CIT's Research Strategy, the primary objective of which is to develop high performing research clusters working in accommodation that is fit for purpose and which facilitates collaboration with industry in particular, as well as with other external collaborations.

The number of research active staff and students in these key areas within CIT has expanded from 29 in 2004 to 65 in 2010. This increase in critical mass has been facilitated by consistent success in funding acquisitions, with core researchers obtaining 84 grants totaling €22.8 million of which over €1.25 million was non-exchequer. This has included two successful projects in PRLTI4, four DOES/HEA TSR Programme grants, two SFI Research Frontiers projects, an SFI Principal Investigator award, an HRB Principal Investigatorship, six Food Institutional Research Measure awards

(FIRMs) and several Enterprise Ireland funded awards and projects. Currently (until new facility completed), the Bio-Explore team is housed in laboratories and offices occupying ~350m^2, which are now over 30 years old, partially shared with undergraduate students and lacking the modern design infrastructure needed for further development. The laboratories are, nevertheless, furnished with €3 million worth of state-of-the-art equipment, including a mass spectrometer, an IVIS bio-imaging system and other high end bio-analytical instrumentation. The Photonics researchers occupy 60m^2 of labs and 40m^2 of office space at CIT (within CAPPA) and 150m^2 of labs and 100m^2 of offices at the Tyndall National Institute, as part of the formal CIT@Tyndall collaboration. The CAPPA labs are located in an aging temporary building. Between them, CAPPA and CIT@Tyndall have approx. €2 million worth of state-of-the-art equipment, including an Environmental Scanning Electron Microscope, FTIR/NIR & μ-Raman Spectroscopy & Imaging facilities, and a Time-Resolved Photoluminescence Spectroscopy setup.

The steady increase in research activity has resulted in the core researchers publishing 168 peer-reviewed papers in the period 2004-2009, with over 800 citations. These include articles in high-impact journals such as Science (IF-30), J. Amer. Chem. Soc. (IF-8), Molecular Microbiology (IF-5.2), Analytical Chem. (IF-5.7), FEMS Microbiol. Rev. (IF-8), and Physical Review Letters (IF-7). Additionally, four senior researchers have an h-index of 15 or more. Five patents have also been filed by the researchers in this period, with more in preparation.

3. Computing

The Department of Computing research activities has developed over many years through collaboration with other third level institutes and with industry. The Department of Computing has strong links, stretching back over 20 years with the University of Applied Sciences in Darmstadt, and with the University of Applied Sciences in Wiesbaden in Germany. Graduates of these universities have completed research based masters and Ph.D. in partnership with CIT. Staff of the Department have visited these universities and one completed a sabbatical in Wiesbaden. A formal agreement between CIT and the University of Applied Sciences in Darmstadt was signed over two years ago. Graduates of Darmstadt can complete an M.Sc. or a Ph.D. in collaboration with CIT. This agreement is currently working satisfactorily and there is now an annual research symposium to allow researchers present their work. A more recent development is the signing of an agreement with the University of Pune in India. Possible collaboration with Pune may come in the area of Bioinformatics.

Staff of the Department of Computing have also assisted industry by undertaking feasibility studies and proof of concepts, availing of Enterprise Ireland grants. Recent projects include the following:

- EU funded IMCORE project: Visualisation for Climate Change. This project entailed the development of software which has been disseminated to 32 partner project around Europe.
- Enterprise Ireland Innovation Partnership: Sensing and Tracking Systems for Training of Damage Control

- Enterprise Ireland Innovation Partnership: Novel Data Entry Systems for Caregivers in Clinical Environments. This project entails the development of a bed side information system for health management.
- Enterprise Ireland Innovation Voucher: Laboratory Information Management System. Multi-user Laboratory Information Management System. This product is commercially deployed to 3 Glanbia food processing plant. Two people have been directly employed as a result of this project.
- Enterprise Ireland Innovation Voucher, Webfios – Cloud Based E-Learning System. A high performance cloud based eLearning system. Multinational Clients secured for product.

Staff within The Department of Computing have collaborated with researchers in the Department of Biological Science to develop software for biotechnology discovery. The team were recently included in a trade mission to Illinois Technology Association where they were invited to provide biotechnology software to the University of Chicago. The software was showcased at the Enterprise Ireland Big Ideas event in October 2010 and has also received Commercialisation funding (€102,000) from Enterprise Ireland in May 2011.

Research Informed Teaching and Learning:
The quality of the research output and the degree of interaction with external stakeholders has had a profound effect on the teaching and learning programmes across all the associated departments within the School. This is the case for both undergraduate and post-graduate teaching and also relates to part-time and full time students. Specifically, the research activity has resulted in enhanced curriculum content, more applied laboratory exercises, access to improved technology and instrumentation, and the development of several new programmes. These include *ab inito* degree programmes in Pharmaceutical Biotechnology, Health & Nutrition and Herbal Science, the joint CIT-UCC BSc (Hons) and MSc in Biomedical Sciences and the proposed MSc in Computational Biology. Development of applied research themes, new technologies and improved visibility across the School has also facilitated the introduction of specialist courses tailored to up-skilling industry personnel including specific bio-pharmaceutical, bio-medical engineering and software/IT courses. The number of final year under-graduates from the departments is approx 200 per annum. Staff within the departments supervise the student projects directly and this also affords new staff or those not currently engaged in research an opportunity to become involved in the research process.

Innovation and Entrepreneurship:
The School is actively involved with CIT's Innovation Ecosystem primarily through the industry led applied research group, the Centre for Advanced Photonics & Process Analysis (CAPPA), working in the fields of optics and photonics. The centre is funded by Enterprise Ireland's Applied Research Enhancement Programme. CAPPA works closely with the School's Photonics Research Group. The School has access to CIT's Entrepreneur-in-Residence, Mr Kieran Moynihan who is based in the Rubicon Centre, CIT's on-campus incubator, helping to support the commercialisation process of the School's research activities.

8 Delivery and Assessment Methodologies

Delivery and assessment strategies within the School are selected to reflect the nature of the elements of the competency, together with the needs and learning style of the students. Delivery of material takes the form of lectures, tutorials and practicals. Materials are delivered in the classroom or laboratories through traditional 'chalk and talk', but also through e-learning methods. Each classroom is equipped with computer and web access. Materials are hosted on the Blackboard platform. Students can access lecture notes and assessments through individual logins through their *mycit.ie* accounts. In some cases assessments can be uploaded directly by students and marked online.

In each course offered by the School, a detailed Programme outcome is included, with specific learning outcomes for that programme. Each programme is made up of a number of modules, and for each module, learning outcomes are produced in keeping with NFQAI guidelines and Bloom's taxonomy. Assessments are created to measure performance and competency in a programme and individual module. The various types of assessments are listed below:

- Multiple Choice Questions
- Short Answer Questions
- Essays
- Case and open problems
- Presentations
- Project, group projects
- Dissertations
- Poster sessions
- Orals
- Reports on practicals
- Direct observation
- Reflective practice assignments
- Portfolios
- Work-based assessment
- Computer-based assessment

In semester 1 of all programmes within the School, assessment is 100% continual assessment. This was a measure taken as a result of retention issues for 1st year students and to also allow a smoother transition for students into third level. Thereafter, assessment takes the form of continuous assessment (types listed above) and/or terminal examination. The Institute has adopted a policy that no more than three modules in a particular semester can be assessed by terminal examination. In year 3 (semester 6) all students undertake a work-based placement, where reflective journals, portfolios and work-based assessments are undertaken.. In year 4 of all BSc Hons programmes a research project is completed, this comprises of a 5 credit preparatory module completed in semester 7 and a 10 credit implementation module in semester 8. The assessment for the research project takes the form of a dissertation, oral and poster presentations.

The appropriateness of delivery and assessment modes is constantly under review and subject to change when the views of the course team, student (QA1/QA2) and external examiner feedback is taken into consideration. The course board can consider changes and make corrective action through the annual module review process.

9 Actions Taken Arising from Reviews

1. **More active and structured engagement with stakeholders, especially students, graduates, employers and other educators.**

   The School has been actively engaged with students through: student reps, staff-student liaison meetings and inclusion of student on course boards. Engagement with Industry has been through; Industry Liaison meetings, facilitated through the Industry Liaison Office and inclusion of industry personnel on new course provision. Additionally engagement with Industry has been helped greatly by the placement module offered to all students on semester 6 of all School programmes. Frequent Schools visits, participation at careers fairs and engagement with schools through the Now Taster programme for Transition year students has greatly enhanced contact with teachers and careers advisers.

2. **Students need to be fully informed of the operation of course boards and of the identities of their representatives on these boards. The student representatives themselves need to be made aware of their rights and status as board members.**

   Class reps are invited onto the course boards for all courses within the School. A pre-meeting with the Head of Department precedes any meeting. At this meeting the students are duly informed of their rights and status.

3. **The review panel was concerned that many course schedules show a contact workload in excess of 25 hours/week. Over the coming 5 year period, these course schedules should be reviewed and contact time reduced.**

   Through the process of Modularisation and Semesterisation, course contact hours and frequency of assessments was considered. In each course within the School the number of contact hours (post year 1) and frequency of assessment was reduced. It was considered by the course teams and external reviewers that greater contact hours was needed in year 1 of al of the Schools programmes, to better equip students and improve retention. An assessment matrix was provided to students at the start of each semester to provide a schedule of assessment and to ensure no overlap of completion dates.

4. **The School of Science has proposed new special regulations regarding (a) examination performance and (b) attendance regulations. These are proposed for inclusion in Course Schedules. The panel suggests a review of the proposal.**

   The School in accordance with Institute procedures removed the use of special regulations regarding examination performance and attendance regulation.

5. **Retention was identified as a serious issue in all the self-study reports, particularly for 1st year students. The review panel urged that radical steps be taken to address this.**

Retention was and still is a major concern for 1st year students. To address this issue the School implemented a process whereby all students in semester 1 of all School programmes had no terminal examinations. The assessment was by 100% continual assessment. Additionally, other measures have been implemented such as the creation of the Creativity Innovation and Teamwork (CIT) module, taken by all 1st year students of the Institute. This module facilitates student-student interaction and engagement of the student in their career planning.. An active decision by the School to develop a BSc/BSc Hons Common Entry Science was undertaken to allow students a greater degree of choice when entering science programmes and to allow a semester to make an informed decision where they wished to direct their career. This affords students greater time and choice and thus reduce withdrawal through wrong course choice'.

6. **The Science facilities viewed by the panel were in most cases excellent, as regards both undergraduate and postgraduate research study. There was evidence of pressure on lab space, especially in Biology, for the carrying out of lab projects, which may be exacerbated by the introduction of the new taught programmes envisaged in the self study. The additional facilities soon to be available will enable the Institute to ensure adequate provision for all programmes and for research activities.**

   The number of students enrolled in the Department of Biological Sciences has risen since 2005 review. However, additional space has been afforded to this Department within the Institute. This has taken the form of 2 additional research laboratories (C149, C149a). This has relieved pressure on teaching laboratories. Also, with the PRTLIV CREATE proposal a 1800 sq ft research building will be developed. All research activity within the Department of Biological Sciences will move into this area and the existing research laboratories will be made available for teaching purposes.

7. **Care should be taken in regard to the identification of prerequisite subjects in the Programme Schedules in order to ensure maximum flexibility of opportunity for potential applicants.**

   The School has adopted (where possible) Institute policy whereby prerequisites will be in avoided. This affords maximum flexibility of choice for students.

8. **The widespread use of industry placement (for periods of 3-4 months) in Applied Physics and Instrumentation and in Chemistry was commended. The value of shorter placements, e.g. one month in Biology, should be reviewed.**

   In discussion with students and Industry representatives (through the SIF funded REAP project Work Placement in Third Level Programmes), it was decided that all placements within the School should be at least 14 weeks in duration

The School of Computing similarly undertook a review in 2005 and below are the key recommendations from the review panel:

1. **Feedback from industry obtained through the self-study recommended developing the students' soft skills.**
   The creation of the CIT module mentioned above has facilitated greatly the soft-skills of 1st year students. Also, where possible and in keeping with the learning outcomes of appropriate modules, oral presentation of projects either individual or group is encouraged.

2. **The *Interpersonal Communications* syllabus in Year 1 of the Higher Certificate is considered to be too abstract for a first year course, and needs more applied content.**
   This is covered in the CIT module (Creativity, Innovation and Teamwork – CMOD 6001) whereby 1st year students are encouraged to undertake project work related to future careers and present both written and orally.

3. **There was discussion as to the need for the *Computer Applications* subject in First Year. The PRG accepts that the content is required in the workplace. It is however suggested that the subject be renamed so as to better reflect the syllabus content, and that the content be better distinguished from end-user focussed subjects with similar titles, for example to *Business Applications* or *Desktop Support.***
   This has been adopted, with module entitled Computer Architecture COMH 6002.

4. **The PRG is of the view that the current course title (Higher Certificate in Science in Computing in Information Technology Support) is too wordy. This should be changed to *Higher Certificate in Science in Information Technology Support.***
   This has been adopted

5. **The review meeting had a fruitful discussion regarding Recognition of Prior Learning (certified and experiential). Practices vary considerably across the Institutes, with in some cases the possibility for credit to be gained for any subject in any stage of the programme. This represents (in the view of the PRG) good practice which should be adopted across the consortium. Exemptions should be standardised where possible.**
   The School has adopted the Institute procedures w.r.t RPL whereby it :
   - Recognises certified learning and learning gained at work formally.
   - Offers an alternative route to those with appropriate experience.

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6. **Industrial placement is a major part of courses, however there was no mention in the documentation of the QA procedures for this placement. This should be addressed by:**
   - Strengthening the placement learning outcomes to focus on the students' development within the company
   - Placement guidelines to be standardised for all Institutes
   - Production of a standard industrial placement handbook, including guidelines for both the student and the company.

The REAP project Work Placement in Third Level Programmes has provided the Institute with standardized guidelines for each of the stakeholders involved in placements:

Institute

- Plan and clearly define responsibilities
- Standardise duration and structure
- Enhance networking and engagement
- Dedicate resources
- Develop employer & student placement packs
- Design structured alternatives to placement

Student

- Participate in preparatory workshops
- Manage & clarify expectations before placement
- Take responsibility for achieving learning outcomes
- Engage in reflective learning activities

Employer

- Assist HEI in developing placement contract/agreement
- Develop job specification
- Support work place learning
- Enhance networking and collaboration with HEI

The School has actively participated in each stage of this programmes development and has adopted these procedures

10 Overview of the School of Science and Informatics' Plans for the coming 5 year period

The School undertook as part of the self-evaluation process an analysis of key performance indicators since the 2005 programmatic review.

Key indicators of performance highlighted areas for improvement, included:

- Student recruitment and retention.
- Adequacy of course provision.
- Research activities and potential
- Adequacy of staff provision and development.
- Internationalisation.

Consequently the School proposes to focus its energies for the next five years on the following objectives:

1. Geographic Focus

The School should be world class at a regional level, of national and international importance in niche areas, in particular Cloud Computing, Bioinformatics and Simulation.

To this end, the School proposes to adopt the following objectives:

1. Develop and run the following programmes by 2014: BSc Hons/MSc in Cloud Computing and MSc in Computational Biology
2. Create the Bioinformatics Research Group as an emerging research area, with the objective to become a Recognised Research Group within the Institute by 2014.
3. Create the Cloud Research Group as an emerging research area, with the objective to become a Recognised Research Group within the Institute by 2015.

2. Student Recruitment

The School recognises the fact that the need for 'non-traditional' students will become greater in third and fourth-level education in Ireland over the next decade.
To this end, the school proposes to undertake the following activities over the next 3 years:

a) Establish a stronger international student cohort in CIT based upon strategic partnerships with:
   * University of Darmstadt, Germany, in the provision of joint postgraduate research studentships (MSc /PhD) in Software research.
   * Dalian Polytechnic University, China, in the provision of studentships leading to BSc (Hons) in Software Development.
   * Hubei University and Wuhan University of Technology, China, in the provision of studentships leading to BSc (Hons) in Pharmaceutical Biotechnology and BSc Hons in Nutrition and Health Sciences
   * University of Pune, India, in the provision of joint postgraduate research studentships (MSc /PhD) in Biological and Chemical Sciences.

b) Engage with Further Education Colleges in Cork City (St John's College, Cork College of Commerce, Colaiste Stiofain Naofa**)** and County (Mallow Community College, Kinsale Community College) to allow access to successful FETAC level 5 and 6 students onto year 1 and in some cases year 2 of courses within the School. Places will be restricted to specific courses and upon successful completion of agreed entry standards.

3. Student Retention

The School recognises that retention is an issue and in particular amongst year 1 students. The School has set at a minimum; improve to Institute average performance across all departments through strategic initiatives.

To this end the School proposes to adopt the following objectives:

a) Develop a common Level 6 Essential Mathematics module that all students on all 1st year programmes within the School must undertake. This will improve Mathematics skills and retention. This will run from Semester 1, 2011.
b) Better engage with students in the critical first 6 weeks of semester 1. Staff student forums will run in this period to better engage with students. The use of e-technologies such as twitters, blogs and wikis will be integrated into the Creativity Innovation and Teamwork Module to engage students with the activities of the Institute and various departments within the School. This has worked very successfully in a pilot scheme run with year 1 BSc Hons Biomedical Sciences students and will be rolled out to all programmes within the School by semester 1, 2011.
c) Develop an e-buddy system whereby year 1 students will be linked up with year 2 students on their programme of study. Training will be provided to year 2 students. This again worked very successfully in a pilot scheme run with year 1 BSc Hons Biomedical Sciences students and will be rolled out to all programmes within the School by semester 1, 2011.
d) Continued support of the Learning Support Centre and improving methods for early detection of students who need additional support.

4. Research

The research performance of the School has been strong over the last 5 years, as evidenced by metrics of student graduating with MSc/PhD, papers published and grants awarded. The School recognises that future performance is strongly related to recruitment strategy and availability of funding, but more importantly and in keeping with strategic objective to focus on industry relevant, multidisciplinary research.

To this end, the School proposes to adopt the following objectives:

a) Create the Bioinformatics Research Group (collaborative proposal from researchers within Biological Sciences and Computing) as an emerging research area, with the objective to become a Recognised Research Group within the Institute by 2015.
b) Increase the metrics of research activity namely: student graduating with MSc/PhD, papers published and grants awarded by 10% year on year from 2011.

c) Increase the number of research active staff within the School by 10% year on year from 2011, by the introduction of competitive seed funding and research awareness. The latter as part of TLU activities and through the structured PhD programme.
d) Increase the number of Innovation Partnerships and Vouchers within the School by 10% year on year from 2011.
e) Maintain level 10 delegated authority in Sciences and to seek approval for same in Computing by 2012.

5. Programme Portfolio
The School recognises the need for Industry relevant, career focused programmes of study/research for students and to maintain viable and sustainable student numbers within existing programmes.

The School strategically proposes to develop:

a) Taught level 9 offerings in the areas of: MSc Cloud Computing, MSc Computational Biology, MSc Instrument Engineering, MSc Bio-Innovation, MSc Pharmaceutical Analysis and MSc Biotechnology. Level 8 offerings in BSc Hons AgriFoods, BSc Hons Pharmaceutical Sciences
b) Tailored programmes in partnership with Local/regional industries for the up-skilling and /or re-skilling of employees
c) Continued Professional Development (CPD) programmes in partnership with professional bodies, in particular the Academy Medical Laboratory Sciences and the Irish Institute of Medical Herbalist, to run from 2012.

6. Talent management – staff development.
The School recognises that its greatest asset is its staff and that increased recognition and development of lecturers in their role as professional and specialist educators should be a prime objective.

To this end, the School proposes to adopt the following objectives:

a) A structured programme of staff development activities be developed in the areas of career and personal development. This will be facilitated through staff development opportunities within and out of CIT. This will be based upon tailored staff development plans in consultation with respective Head of Department and subject to budgetary constraints.
b) Where appropriate, staff engage in the newly validated MA in Teaching and Learning.

7. Enhanced Collaboration and Engagement

The School recognises that it needs to consolidate and expand it's relationships with industry and other external bodies.

To this end, the School proposes to adopt the following objectives:

a) Work closely with the CIT alumni association to re-establish links with our graduates and make use of such links especially with prominent graduates to further promote CIT science and informatics.

b) Improve outreach through Black Castle Observatory (BCO) in order to promote science generally within the local community. This will take the form of staff lectures, school visits and opening of the School's facilities to secondary schools and community colleges between semesters.

c) Increase its presence on Professional and Industry bodies such as it@cork, PharmaChem Ireland, Academy Medical Laboratory Sciences

d) Strengthen international activities (Germany, China and India) to expand portfolio of courses offered and improve visibility.

e) Strengthen activities with local and regional FE colleges to expand portfolio of course offered.

f) Strengthen activities with UCC to develop opportunities to promote, market and enhance the Biomedical Sciences offering.

The table below has outlined a 5 year implementation plan for these objectives:

Activity	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Geographic Focus	BSc/MSc Cloud Computing MSc Computational Biology	Expand Bioinformatics Research Group	Develop strategic alliances with Bioinformatics & Cloud centres of excellence	Bioinformatics RRG	Develop Cloud Research Group	Cloud RRG
Student Recruitment	10% increase overseas students 10% increase in non-stds	10% increase overseas students 10% increase in non-stds	10% increase overseas students 10% increase in non-stds	10% increase overseas students 10% increase in non-stds	10% increase overseas students 10% increase in non-stds	10% increase overseas students 10% increase in non-stds
Student Retention	10% increase Essential Maths module e-buddy system 1st yrs	10% increase e-buddy system 2nd yrs	10% increase e-buddy system 3rd yrs	10% increase	10% increase	10% increase
Research Activities	10% Increase Funding, Papers, PhD Students	10% Increase Funding, Papers, PhD Students	10% Increase Funding, Papers, PhD Students	10% Increase Funding, Papers, PhD Students	10% Increase Funding, Papers, PhD Students	10% Increase Funding, Papers, PhD Students
Enhanced Programme Portfolio	BSc/MSc Cloud Computing MSc Computational Biology	MSc Instrument Engineering CPD Delivery AMLS	MSc Bio-Innovation CPD Delivery IIMH	BSc Hons Agri-Foods	BSc/MSc Pharmaceutical Analysis	MSc Biotechnology
Staff Development Activity	10% Increase involvement	10% Increase involvement	10% Increase involvement	10% Increase involvement	10% Increase involvement	10% Increase involvement
Collaboration And Engagement	Link in with CIT Alumni. Develop County FE links	Development of Outreach activities with BCO Strategic Links China, Saudi Arabia	10% increase of presence on boards of professional bodies	Development of Schools outreach programme		

Table 10.1

11 FACILITIES

Department of Applied Physics and instrumentation

Support Facilities

C212 Lecture Room	25 m^2 (max 30 students)
C214 Lecture Room	55 m^2 (max 55 students)
C219 Computer Room	20 m^2 (max 25 students)

Laboratories

C215 Teaching Laboratory (15 capacity)
C222 Teaching Laboratory (10 capacity)
C223 Teaching Laboratory (20 capacity)
C228 Teaching Laboratory (20 capacity)
C229 Teaching Laboratory (20 capacity)
C230 Teaching Laboratory (20 capacity)
C234 Teaching Laboratory (20 capacity)

Department of Biological Sciences

Support Facilities

B241L Lecture Room	20 m^2 (max 25 students)
B248 Lecture Room	55 m^2 (max 55 students)
C230 Lecture Room	65 m^2 (max 75 students)
D230 Lecture Room	20 m^2 (max 25 students)

Laboratories

C147 General Biology Research	110 m^2
C149 General Biology Research	40 m^2
C262a Technical Preparation Area	36 m^2
C267 Technical Preparation Area	54 m^2
C256 Cell Biology Lab	90 m^2
C262 Biomedical Lab	90 m^2
C268 General Biology	110 m^2

Department of Chemistry

Support Facilities

C248 Technical Preparation Area	36 m^2
C260 Chemicals & Equipment Store	54 m^2
Chemicals Storage Cabin (pre-fab)	12 m^2
D237 Lecture Room	54 m^2 (max 55 students)
C236 Lecture Room	54 m^2 (max 36 students)

Laboratories

C241L Chromatography	36 m^2
C243 Analytical Chemistry	72 m^2
C245 Spectroscopy	54 m^2
C247 Inorganic & Physical Chemistry	72 m^2

C251 Organic Chemistry	90 m^2
C263 Organic & Biological Chemistry	90 m^2
C252 General Chemistry Research	90 m^2
C244 Proteobio Research Unit	36 m^2
C143 Proteobio Research Unit	36 m^2
C144 Advanced Spectroscopy	36 m^2
C145 Proteobio Research Unit	54 m^2
C148 Laboratory Information Management Systems	54 m^2

Department of Computing

Support Facilities

B217, B219	45 capacity
F1.2	40 capacity
PF53, PF54	40 capacity
C170 (50% share with Business Studies)	40 capacity

Laboratories

IT1.2, IT1.3, IT2.1, IT2.2, IT2.3	20 capacity
C128 Multimedia,	20 capacity
C134 Architecture,	20 capacity
C134X Realtime	20 capacity
C136 Networking	24 capacity
C129 Networking	16 capacity.
IT1.4, C127 project labs -	20 capacity

12 Attachment – Key Recommendations from BiopharmaChem EGFSN

http://www.skillsireland.ie/media/egfsn101115-Biopharma_Pharmachem_Skills.pdf

Recommendations

1. **Strengthen business skills within the sector**
   This study has identified that business skills in the Irish biopharma-pharmachem industry need to be strengthened. These skills will be essential if the sector is to continue to develop and compete internationally. In particular, the EGFSN recommends the following:

- ✶ Business skills should be embedded in science and technology programmes, ensuring that graduates emerge with some business knowledge. For example, this would include innovation, entrepreneurship, IT and lean skills. (Responsibility: HEA, HEIs)
- ✶ Student work placements should be used to familiarise students with the working environment and to enhance their business acumen (Responsibility: HEIs, PharmaChemical Ireland, Irish BioIndustry Association)
- ✶ Mentoring and development programmes in business strategy for the industry's senior management will be required to ensure leadership in the sector. (Responsibility: Enterprise, IDA, Enterprise Ireland)
- ✶ State Agencies should continue to provide programmes that improve the industry's business skills. This will include provision by Enterprise Ireland, including offerings in leadership, lean techniques and sales and marketing. Skillnets will also be a useful vehicle in providing business programmes for indigenous and international companies. (Responsibility: Enterprise Ireland, Skillnets)

2. **Align education and training provision with industry's requirements**
   The stakeholder consultation for this report revealed that there needs to be a greater alignment of education and training provision with the biopharma-pharmachem industry's requirements. The EGFSN recommends the following in this regard:

- ✶ Ensure science and technology programmes are aligned with industry's needs on an ongoing basis. This will include ensuring that course material includes peer review papers as well as textbooks, and reflects current industry practice. Industry will need to ensure that it keeps education and training providers informed of its requirements.
- ✶ Informatics, bio-informatics, business and generic skills will need to be embedded into S&T programmes
- ✶ Ensure that CPD provision continually meets industry needs and can be delivered in a flexible manner. This will include provision by public and private institutes and state agencies.
- ✶ The National Institute for Biotechnology Research and Training (NIBRT) is just beginning to roll out its training programmes. NIBRT will need to ensure that it has access to the best academic research, on an ongoing basis, and that its training programmes are aligned with industry's needs. (Responsibility: HEIs, HEA,

Enterprise Ireland, FÁS, VECs, Skillnets, NIBRT, PharmaChemical Ireland, Irish BioIndustry Association)

3. Enhance Industry-Academia Collaboration

The research for this study showed that many links between industry and academia in Ireland are informal and rely on individuals rather than structures and formal processes, which is not sustainable. The Irish higher education system does not actively support or reward engagement with industry, with performance measures for academic staff focusing on numbers of graduates produced, papers published and funding obtained. In contrast, the study visits conducted in North Carolina, Singapore and Switzerland show that industry-academia collaboration is strong and plays a critical role in ensuring that graduates are equipped with skills required by industry. The EGFSN recommends the following to strengthen industry-academia collaboration:

- ✶ Formal structures and processes be put in place to ensure industry involvement in programme design and revision. (Responsibility: HEA, HEIs, PharmaChemical Ireland, Irish BioIndustry Association)
- ✶ Industry engagement be criteria considered for faculty appointments and promotion. HEI staff could also be encouraged to take sabbaticals to gain industry experience, and measures be taken to ensure that they are not penalised for that in their academic careers. This echoes recommendations of the Innovation Task Force and the Advisory Council for Science Technology and Innovation95. (Responsibility: HEA, HEIs)
- ✶ Industry professionals be used where appropriate in the delivery of course modules where the main expertise is in industry. (Responsibility: HEA, HEIs)
- ✶ Industry collaboration be a criterion for funding of HEI programmes. (Responsibility: HEA)
- ✶ Collaboration with research institutes in international locations such as Singapore, North Carolina and Switzerland be explored. (Responsibility: NIBRT, SFI, HEIs)

4. Develop Structured Postgraduate Programmes

The research for this study indicated that many postgraduate programmes in HEIs are research focused, oriented to the academic profession and do not prepare students for a wider employment market. This corroborates the findings of Advisory Council for Science Technology and Innovation in 200996, which recommended the development of structured doctoral programmes, moving away from the traditional model of the student-supervisor relationship to a more structured research degree programme including research and generic skills development. The 2009 Forfás report on the health life sciences sector97 makes a similar recommendation. This is also reflected in cycle 5 of the Programme of Research in Third Level Institutions (PRTLI) which includes a structured PhD in Life Sciences.

The EGFSN recommends the development of structured research masters and PhD programmes in biopharma-pharmachem disciplines, that would include taught courses as an integral part of the programme, and a student work placement of at least 6 months. Ideally, students would have the option to either complete a Masters programme or decide to transfer to a PhD programme after 12- 24 months. (Responsibility: HEA, HEIs)

5. **Develop a standardised student work placement for all HEI biopharma-pharmachem related disciplines**

   Stakeholders consulted for this study, including industry and HEIs in Ireland and in the three international locations visited, considered student work placements an important part of science and technology programmes, giving students practical experience of the working environment. Yet, large numbers of students taking biopharma-pharmachem related courses in Ireland do not have access to a placement. While most institutes of technology programmes and some university programmes include work placements, it is not commonplace in most university programmes. The research for this study also showed that these placements differ in structure depending on the HEI or individual departments within HEIs. A number of core factors emerged as contributing to effective student work placements and should be progressed:

- ✶ Ensure that students taking biopharma-pharmachem related courses have access to a work placement
- ✶ Placements should be of 6-9 months duration and incorporate academic holiday periods if necessary.
- ✶ A partnership approach between industry, HEIs and students should be encouraged in the provision of work placements
- ✶ Placements should be sought in companies in Ireland and abroad
- ✶ While every effort should be made to secure placements for students in companies, alternative locations could be explored such as education/research institutes.
- ✶ Subject areas where the main expertise is in industry should be covered during the student work placement. This would include areas such as commercial awareness, business development, communication skills and problem-solving. Some technical areas, such as compliance, where industry has the main competence could also be covered. (Responsibility: HEA, HEIs, PharmaChemical Ireland, Irish BioIndustry Association)

6. **Address the strategic development of the Pharmachem sector by providing dedicated research and training**

- ✶ The EGFSN recommends that dedicated research and training in areas such as process development, synthesis, process analytical technologies (PAT) and formulation be provided to address the strategic development of the pharmachem sector. This will include horizon scanning of the environment on an ongoing basis to determine research and training needs, and provision of that research and training when demand is identified. While there is a dedicated agency (NIBRT) to address the research and training needs of the biopharma industry, no such facility exists for the pharmachem sector. If the industry is to achieve its strategic goal of increasing on-site innovation such as process and product development, a dedicated research and training resource will be required. This need was also identified by the Advisory Council for Science Technology and Innovation98.

  The EGFSN recommends that this be done either through institutes that are already in place, such as the National Institute for Biotechnology Research and Training (NIBRT), or developing a separate virtual structure, through existing CSETs for

example, drawing from appropriate expertise throughout academic institutions and industry. (Responsibility: IDA, SFI).

- One such training need in the area of process development was identified in the course of this study and will need to be met in the immediate term. As the industry moves to consolidate its manufacturing expertise by incorporating late stage development, technologists with both engineering and science skills will be required. This calls for engineers and chemists to have strong core disciplines but also a good knowledge of each other's discipline.

  The EGFSN recommends that a masters or postgraduate diploma programme in transition skills be developed, with industry driving the course content. These courses, or constituent modules, could also be offered to industry executives to ensure upskilling within the industry. (Responsibility: HEIs, HEA, PharmaChemical Ireland)

7. Develop an operative upskilling programme

As the biopharma-pharmachem sector undergoes essential change, the operative role in the sector will also change. Operatives will need to be flexible and skilled in a number of areas, including information technology, analytical offline testing, mechanical changing of equipment, chemical engineering and chemistry. Operatives will also be required to work in teams and will need to develop team-working skills. The EGFSN recommends that:

- An upskilling programme targeted at operatives be developed to include full-time and part-time programmes at NFQ levels 6 and 7. Some initial provision at NFQ levels 4/5 for those who have been in the workforce for some time may also be required.
- Provision of these programmes be made available through flexible delivery modes. (Responsibility: Skillnets, FÁS, HEIs)

13 Attachment – Key Recommendations from EGFSN.

Recommendations from EGFSN on the Requirement for High-level ICT skills in the ICT Sector.

http://www.skillsireland.ie/media/egfsn080623_future_ict_skills.pdf

Conclusions and Recommendations

The conclusions and recommendations set out below correspond to three major strands of issues identified by this report, i.e.: Providing a sufficient quantity of skills; Providing skills of sufficient quality; and Providing a sufficient diversity of skills to reflect the complexity and diversity of ICT businesses.

A main conclusion of the report is that the projected domestic supply of high-skilled computing and electronic engineering graduates will need to be boosted to meet future demand. Because of the need to bridge the gap in high-level ICT skills, inward migration – already a significant part of the skills supply – will continue to be an important source into the future. This is against the background that the ICT sector here has largely recovered from the global downturn in market demand experienced in 2000/01 and is now growing again – with both productivity and profitability rising. Labour market demand for high-level ICT skills here is increasing while at the same time the flow of computing and electronic engineering graduates has fallen. This can be seen against the background of a global-wide shortage of high skilled ICT people. The quality of ICT staff here is also a key issue and is likely to remain so as long as the number of high performing students choosing to study courses in computing and electronic engineering remains modest – even though there are good career opportunities in these occupations. Based on these findings, the EGFSN are recommending proactive measures designed to increase the supply of high-skilled personnel (both in terms of quantity, quality and diversity of skills) to meet the future needs of the ICT sector. The successful implementation of these recommendations will require a collaborative approach between the many stakeholders involved. While the recommendations are designed to support the ICT sector, and specifically to address its high-level skills needs, some undoubtedly will have a positive impact on adjacent sectors, and support the wider agenda on skills for enterprise. The main measures the recommendations focus on are: A strategic approach towards communicating career opportunities and skill needs; Broadening the base of recruits for high-level ICT courses; Improving intake at undergraduate level; Ensuring third-level courses reflect the skills mix/diversity of ICT business; Improving intake from third-level into the ICT sector;. Supporting computing and electronic engineering educational capacity; and adopting proactive labour market strategies. The recommendations from the study are summarised as follows.

Recommendation 1:
Communicating Career Opportunities that Exist in Computing, Software and Electronic Engineering

A major new initiative should be launched to communicate the rewarding and interesting career opportunities that exist in the fields of computing, software and electronic engineering in line with the CAO application process. The vital strategic role that the ICT sector plays in ensuring Ireland's long-term prosperity should be

highlighted. It should seek to address concerns (real or perceived) about job security in the ICT sector which influence students' choices. All stakeholders, including employers, their representative bodies and the Higher Education Authority (HEA), should work together to develop a coherent message, containing hard facts, aimed at three specific audiences: Students at secondary level; Parents; and Teachers/Career Guidance Counsellors. There needs to be a gender dimension to this communication aimed at addressing the relative decline in the number of women taking high-level ICT courses. This new initiative, (which would include revitalised actions already underway), should be led and coordinated by Discover Science and Engineering given their experience in this area. The recommendations of the Expert Group on Future Skills Needs Careers and Labour Market Information Dissemination report should be implemented expeditiously. In summary, these are about: Development of a careers and labour market portal; Promotion of existing careers web sites; improving access to useful labour market information; and Improving existing career guidance and information resources. The Expert Group encourages guidance practitioners to be aware of the current positive outlook for the ICT sector both worldwide and in Ireland, and to regularly update their information on the sector.

Recommendation 2:
Communicating Future Skill Needs The Expert Group on Future Skills Needs,
The HEA and ICT Ireland should facilitate discussions between industry and third-level institutions on an annual basis with a view to deepening engagement between employers, third-level institutions around ideas to improve: Recruitment onto third-level computing and electronic engineering programmes; the development of careers paths in the industry; and the relevancy of industry programmes.

Recommendation 3:
Enhancing the Professional Development of Primary Teachers
The professional development of primary teachers would be enhanced by including further development in mathematics through Professional Master Courses and opportunities to enhance 'academic mathematics'; Improve the allocation of time and resources to be given to the development of mathematics competence in teacher training courses; and The Primary Curriculum Review indicates that children are enjoying the active engagement with mathematics and the methodologies being employed in class. This should be continued and reinforced at second-level.

Recommendation 4:
Tackle the Incentives for Studying Leaving Certificate Mathematics at Higher-level
The Department of Education and Science should work with Higher Education Institutions to address the disincentives to studying Leaving Certificate mathematics at Higher-level. In doing so, it should: Promote the development and introduction of a system of bonus college entry points for Higher-level Leaving Certificate maths to compensate students for the greater effort widely considered to be required for success in this subject; and Ask the State Examinations Commission to propose and implement a response to the grading penalty that appears to be suffered by students taking Higher-level mathematics in the Leaving Certificate. These initiatives should be seen in the context of a leveling of the 'playing pitch' in the choice open to students between taking Higher-level maths and other subjects.

Recommendation 5:

Enhancing the Professional Development of Second-level Mathematics Teachers

The quality of second-level mathematics teachers is central to driving up interest and mathematics proficiency levels. The Department of Education and Science should continue their support for initiatives aimed at enhancing the quality of mathematics teaching in secondary schools. This should comprise professional development opportunities for second-level mathematics teachers including a Professional Masters Degree (taking account of professional experience) and a part-time Higher Diploma in Mathematical Education. Consideration should also be given to the introduction of a 4 year Honours Degree in Mathematical Education to provide another source of mathematics teachers. Industry and higher education institutions should improve feed back to teachers about the vital practical applications of mathematics. A more interactive, imaginative approach to teaching mathematics as being developed by the National Council for Curriculum Assessment (NCCA) within "Project Maths" should be supported in which students are engaged in discussing real-life situations and how the mathematics involved can be applied to them – so that students can see its relevance to themselves and the world around them.

Recommendation 6:

Consider the Introduction of Bursaries to Boost the Recruitment of Highly Qualified Students into Honours Level Computing and Electronic Engineering Bachelor Degree Courses, as a Matter of Urgency

In order to boost the recruitment of high qualified students into Level 8 computing and electronic engineering courses bursaries could be introduced for students entering such courses who achieve a demanding CAO point's threshold of 500 points1 and a minimum requirement in higher-level maths2. The introduction of bursaries, on a pilot basis in the first instance, should be urgently assessed by the relevant Departments as an integral part of the package of measures being proposed. The private and public sectors should pursue the funding for any such pilot scheme from the ICT Sector and the National Training Fund. The involvement of HEA, DETE and Business would be required in the management of the process3. Bursaries could be valued at up to €4,000 per annum, and would be conditional on students maintaining acceptable grade averages and undertaking relevant industrial experience (which may be undertaken during the summer break). It is envisaged that between 150 and 180 new graduates per annum may become eligible for this initiative4 (with an outer limit of 300 on review of uptake). Similar STEM course incentives exist in several countries such as the UK, USA, Australia and learning from these could be drawn upon.

Recommendation 7:

Proactively Encourage High-skilled Overseas ICT Students to Come, Study and Work in Ireland

A major new initiative should be launched aimed at: Attracting a greater number of overseas computing and electronic students to come and study here; and seeking to retain such overseas students here, to work in the ICT sector following their graduation. Employers, HEA, Universities and Colleges, IDA Ireland, Enterprise Ireland and the International Education Board Ireland should collaborate on the development of a major new initiative focused on attracting overseas computing and electronic engineering students that markets Ireland as "the place to come, study and work". This should

include offering such students an attractive package including the certainty of internships during their study period and graduate placement opportunities following (and subject to) their graduation5 (The Third-level Graduate Scheme (2007) under the new economic migration regulations, enables a non-EEA student who has acquired a primary, masters or doctorate degree from an Irish third level educational institution to apply for one non-renewable extension to their current student permission for a six-month period6 to seek employment). This overall package is necessary to compete with other English speaking countries that currently offer such incentives such as the USA, Australia, Canada and New Zealand. 1 In 2006, this was achieved by 10% of acceptors (19 students) for Honours Bachelor Degree Courses in Electronic Engineering and 4% of acceptors (42 students) for Honours Bachelor Degree Courses in Computing. 2 To be decided in consultation with Third-level Institutions – suggested that it should be between C3 to B3. 3 The pilot process could be reviewed annually and its outcomes evaluated at the end of year three, following which a decision would be made to modify, expand and/or terminate. 4 An eligible student would receive the bursary for each of the four years of their study, (conditional on meeting criteria). Therefore, the envisaged total number of students benefiting from the bursary could be 180 in the first year of its introduction, 360 in its second year, 540 in its third year and 720 in its fourth year – thereafter the total would remain at 720 as students exit following their graduation. The estimated cost of the initiative could be €0.72m in the first year rising to an €2.88m (constant prices) in year four and for subsequent years. 5 This package would be promoted through Enterprise Ireland and IDA offices abroad and offered directly to prospective students at forthcoming graduate fairs in 2008 being held in the USA, Norway, Mexico, India, Malaya, Singapore etc. which International Education Board Ireland will attend. 6 During this six-month period they are allowed to work for up to 40 hours per week. 14

Recommendation 8:
Produce More Graduates with Strong Engineering Skills
Several ICT companies consulted for the study identified problems in recruiting enough people with very high-levels of technical capability, whether at graduate or experienced level. Those finding difficulties at graduate level tended to identify the need for more technically challenging project work on undergraduate programmes as an issue, and drew comparisons with 'strong engineering schools' in the US, and with challenging degree programmes in countries in Central Europe. More generally, the reduced numbers of students entering college with high Leaving Certificate grades were seen as an issue. As a majority of companies said they were happy with the capabilities of the graduates they see, the current requirement for change is not across-the-board. As with the US, courses that are highly intensive technically can co-exist well with courses whose differentiating strengths lie in other areas. Thus there is a need not only to boost the number of students with high grades choosing to study computing and electronic engineering at Level 8; but also to strengthen the most technically intensive programmes at this level, and even introduce new technically intensive courses if sufficient demand can be established. The Higher Education Authority should continue to provide funding to Higher Education Institutions to further develop and improve the attractiveness of the most technically intensive Level 8 programmes in computing and electronic engineering and subject to demonstrating a viable level of student interest, to enable institutions to develop new programmes focused on developing strong engineering skills. A small number of such programmes are required. The graduates of

these programmes will provide skills for the most technically challenging work in the ICT sector in areas such as systems software, electronics design and development of complex networked applications.

Recommendation 9:
Produce More Graduates with Domain-specific Knowledge
One of the major needs identified by software companies is for more people with expertise both in computing and in business. People with these skills are required for roles in areas such as business analysis, product management, product development, sales and provision of services to customers. While a broad knowledge of business is useful, what companies want most are people who are expert in the application domain in which their products and services are used (e.g. banking). In order to develop domain specific knowledge (deep knowledge of sectors in which applications will be used) and business competencies, Higher Education Institutions should consider further developments in the following areas, whether through modifying existing programmes or establishing new ones should a sufficient demand from students exists. Specialist taught masters programmes combining technology and business, each focused on the specifics of an application sector in which the Irish ICT sector has a strong presence, such as banking or telecommunications, and made available full-time and/or part-time, and targeted on both existing high level ICT professionals and new Level 8 ICT graduates; Undergraduate Honours Bachelor Degree programmes combining technical and domain-specific business skills (such as a BSc in Banking Industry Technology or a BSc in Telecommunications Industry Technology); Industry-focused training programmes for working technologists, focused on industry domains that are important to a significant number of Irish technology companies (e.g. financial services); and Higher diploma/graduate diploma conversion courses, designed to introduce graduates in any discipline to computing. Where possible these conversion courses should feed masters programmes designed to deepen the technology skills learned.

Recommendation 10:
Boosting Postgraduate Training
Postgraduate education has important functions in: Upgrading skills – giving students and professionals opportunities to improve and deepen their existing skills in areas such as software engineering; and Specialisation – providing opportunities to graduates who already have a strong general foundation of skills from an undergraduate degree in an ICT-related discipline to specialise in a particular technology or industry area. While some specialisation can be accommodated at undergraduate level, much of the requirement for specialised courses can only realistically be accommodated at postgraduate level. The HEA should be supported in continuing its strategy of promoting and supporting study on master courses (both part-time and full-time) in order to: Boost skill levels; Develop industry-relevant skills specialisations; and providing lifelong learning opportunities.

Recommendation 11:
Graduate Internship and Placement Programmes
Industry regards internships as an invaluable means of preparing students for work. It is recommended that they should become an integral part of both undergraduate and postgraduate courses. Graduate placement programmes have been useful in providing

young people with temporary work experience after graduation and helping them get a job. They should be continued where they remain helpful to students and companies.

Recommendation 12:
Support Computing and Electronic Engineering Educational Capacity
The Higher Education Authority should continue their support for Higher Education Institutions computing and electronic engineering departments while undergraduate enrolments continue to be depressed. It should also continue to underpin measures aimed at improving retention and recruitment on ICT programmes. The Higher Education Authority should fund Higher Education Institutions to innovate within their current Level 8 course portfolios in computing and electronic engineering, in order to increase the marketability and relevance of such programmes. ICT Sector 7 Publica Consulting (2006) Changing Nature of Skills in Selected Occupations: A Report to the EGFSN & Forfás.

Recommendation 13:
Demonstrate the Attractiveness of Careers in ICT sector
It is important that industry is competitive and able to attract the level of high-skilled graduate recruits it requires to meet its future skill needs. Industry must demonstrate that rewarding and attractive career paths are available for young people taking up employment in their sector. This is something which ICT firms, working together with their representative bodies could best achieve.

Recommendation 14:
Continuing Professional Development
Third-level institutions, while having improved in recent years, should do more to engage with enterprises to provide flexible, accredited training course options responsive to the needs of enterprises and individuals. Computing and electronic engineering are professions in which constant learning is required, both in technology and in related business skills. Continuing professional development should be supported by ICT companies as the main way that high-qualified computer and electronic engineering staff (at Level 8) can upskill and re-skill to Level 9 (possibly Level 10). This can be done through part-time master courses, in-company training, self-learning etc. Shorter courses in generic skill areas such as communications, team working, problem solving, report writing, innovation and creativity skills would also be valuable. The establishment of technology focused networks of high-level ICT staff is important (both within companies and beyond) as such networks play an important role in improving company performance and driving innovation7. Industry representative bodies should support the development of such networks.

Recommendation 15:
Attract Skills Through Foreign Recruitment
Recognising that the domestic supply of high-skilled ICT graduates will not meet the immediate needs of the ICT sector and against a background of a world-wide shortage of high-skilled ICT people another source of supply is through foreign recruitment. Mobility between Ireland and other major centres of ICT industry is also important to the cross-fertilisation of ideas and practices, which underpins innovation. Ireland has a strong international reputation in IT and high-skilled people in other European countries

would be positively disposed to careers here. To attract high-level ICT recruits from within the EEA, employers and their representative organisations should work closely with the European Employment Services EURES programme (operated in Ireland by FÁS). EURES Ireland's good knowledge of labour market conditions across EEA countries and their entrée into European Employment Placement Services can facilitate ICT company recruitment drives. While there is an upturn here in the ICT sector, this is also the case in several other European countries such as Sweden, Finland, Norway and the Netherlands who are also sourcing high-skilled professionals abroad. High-level ICT staff from outside the EU form an important part of the supply available to ICT companies in Ireland. Where the skills required reside outside the EEA, the Department of Enterprise, Trade and Employment should ensure that applications for non-EEA migrants are processed quickly and efficiently within the boundaries of the economic migration regulations introduced in January 2007, and that the regulations are interpreted consistently and predictably. The occupations within the ICT sector deemed to have skills shortages should continue to be reviewed by the Expert Group on Future Skills Needs, and advised to the Department of Enterprise, Trade and Employment.

14 Attachment – Analysis of Issues Facing Third Level Institutions in Ireland

Analysis of issues facing third level Institutions in Ireland in the area of Education and Research in Computing.

http://thirdlevelcomputingforum.ie/

The Third Level Computing Forum is a forum, supported by Enterprise Ireland, which contains heads of third level academic computing departments [Both University & Institute of Technology] with software development programmes, senior industry executives from the ICT sector and representatives from the Higher Education Authority, IBEC, Irish Software Association, Science Foundation Ireland and Enterprise Ireland.

The Third Level Computing Form supports discussion and co-operation between organisations interested in computing education, including the third level colleges, industry bodies, Government agencies, and companies. It was set up by the National Software Directorate and is supported by the Department of Enterprise.
As other parts of the Irish economy suffer, the software sector continues to prosper. Demand for graduates in computing and related disciplines has kept growing and is greater than the supply. So far the shortfall has been made up by computing graduates from other countries, with over 50% of new hires in software companies coming from abroad. Longer term we will need to provide our own, as world-wide demand increases for graduates able to design the systems of tomorrow.

The shortfall is not just in computing graduates. If people generally are to have any understanding of the systems they use, any appreciation of new possibilities, they will need some grasp of computational thinking. Without this, they will at best be superficial users, unable to understand the associated costs and dangers, or appreciate the possibilities. We need to add 'computational thinking' to 'reading, writing and arithmetic' as another pillar of a practical education. By failing to do so we neglect the educational implications of a world where almost every aspect of life will involve computation based systems.

It's not just Ireland that faces these challenges. President Obama has been warned of the failure at second level to distinguish between 'information technology literacy' and 'computer science', and urged to "Consider computer science as one of the core courses students need to develop critical 21st Century skills". (/www.acm.org/public-policy/ACM_CS_ED_Transition_Final.pdf). At third level in the UK, Prof. Muffy Calder has pointed out that "Computational thinking, a way of solving problems, designing systems and understanding human behaviour, drawing on concepts of computer science, is having a wide impact across all disciplines." (www.ukcrc.org.uk/rae-2009.pdf). The growing appreciation of these issues abroad makes it all the more important that we address them effectively here.

In doing so, one strength is the co-operation that already exists between the third level sector and industry and the significance attached to this by the industry. "It's vital that

we support the connection between the world of education and the world of business to ensure we continue to bring new ideas, new computer science students and expertise that can help drive innovation and entrepreneurship. Our support for the Third Level Computing Forum and its activities is recognition of the importance of that link." (Mr. Liam Cronin, Microsoft Ireland).

In Ireland, third level computing education is available in 7 Universities, 14 Institutes of Technology, in Tipperary Institute, and in a number of private colleges. Four year honours degree courses (National Framework of Qualifications Level 8) are provided by most of these, with two and three year courses at Level 6 and Level 7 available, mostly in the Institutes of Technology. All the universities and most of the institutes are involved in postgraduate studies and research in computing.

Numbers studying computing have not recovered from the drop of over 70% in applications for computing degrees in the 2001-2003 period, following the 'dot.com' collapse, though there have been some increases in recent years. A similar situation exists in other countries.

The slowness of the recovery in the numbers reflects various underlying problems. Confidence lost in the 'dot-com collapse' of 2001-2003 has not been regained. "There are no jobs in computing"! The strong employment opportunities are not understood. Computing does not have a clear identity in the community. There is little understanding of what it involves, and a tendency to confuse it with Electronics, Mathematics, or computer manufacturing.

The professional career opportunities and general educational value of computing qualifications are not appreciated. There is a fear that such qualifications provide only limited career options.

The image of the computing graduate is of the 'nerd' rather than the 'professional'.
It is seen as a predominantly male area of interest.

Ireland is one of the few Western European countries in which there is no study of computing, as distinct from use of computers, at second level.

The resulting difficulties for the colleges include

- Empty places on virtually all full-time computing courses.
- Very low numbers of women on most computing courses.
- A decline in the Leaving Certificate grades of computing students.
- High failure and drop out rates, particularly in first year, where most students encounter programming for the first time. Students are ill prepared to study computing at third level.
- Difficulty in recruiting Irish graduates to do research.

As a result, the numbers graduating in Ireland fall well short of industry's needs and of those of research.
The Expert Skills Group predicts a shortfall of 2000-3000 computing graduates per annum in the coming years. (ICT Report 2008)

More than 50% of graduate hires in software companies in the Dublin area are from outside Ireland.
More than 50% of postgraduate research positions in the colleges are filled by graduates from outside Ireland
Other countries also have computing graduate shortages
The USA employment in Information Technology grew by 8.7% in 2007
Western Europe economies generally have a significant shortfall
India and China have significant shortfalls

This shortage of computing graduates has important economic consequences

- It hampers development of the 'knowledge economy'
- It hinders effective use of computing in improving competitiveness.
- It limits innovative use of computing in new products and services
- It limits the development of the software sector, an industry ideal in many respects for an economy such as Ireland.
- It makes Ireland reliant on an uncertain supply of graduates from other countries, both for industry and for research

Continuing attempts are being made to address the issues
All the colleges have invested in activities to promote computing, including

- School visits
- Special courses for second level students
- Promotional materials, printed, DVD, and WWW based
- Open days
- Appointment of a marketing officer for computing
- Articles and interviews in the media.

Virtually all colleges have developed new courses aimed at capturing the interest of students in areas such as computer games, forensic computing, business computing, multimedia and business computing
All the colleges have taken steps to address the problems of failure and drop-out, in particular by providing additional tutor support. Funding has been made available by the HEA to cover the associated costs.
The state agencies, in particular the Higher Education Authority and Enterprise Ireland, and professional bodies and industry bodies, including Engineers Ireland and ICT Ireland, have co-operated in funding various initiatives and campaigns aimed at increasing take up of places in computing courses.
Although there has been no shortage of effort, innovation and financial support, recovery in the numbers remains slow, though there has been some progress. However, without these efforts, it seems likely that the situation would have deteriorated further.

It is felt that the existing efforts should be continued.

In addition, the following steps are suggested to help address the underlying issues

- That the industry seeks the co-operation of the media in clarifying the job situation and the career prospects of computing graduates, and in overcoming the 'nerd' image. The colleges can help, but their views are at second hand and may be seen as tainted by vested interest.

- That steps are taken to provide a better understanding of what computing and computational thinking are about, and to distinguish them clearly from hardware technologies, mathematics, and computer manufacture. At present it is as though the civil engineering involved in a hospital were confused with the medical procedures carried out inside it.
- That the importance of computational thinking as a component in basic education be recognised.
- That the broad educational value of the study of computing be highlighted, to help reduce fears of limited career options. A computing based degree can be as broadly educational as a degree in business or economics or a modern language. Few disciplines touch on such a wide range of topics.
- That further efforts be made to attract women to study the subject. At present they have surrendered it to the men. Many seem to be unaware of the interest, flexibility, and prospects that a career in computing can offer. They seem unaware of the potential of computing to help people's lives.
- That all Teacher Training, whether at Primary or Second level, involve the study of Computing, to cover at least basic Computational Thinking, Algorithms, Computer Programming, and Computer Architecture. At present it is infeasible to introduce computing in the second level curriculum due to unavailability of teachers, but this should not be allowed continue indefinitely. Teachers should be given the opportunity to become aware of the subject, and perhaps interested in it.
- That the colleges identify ways in which they might interact more closely with local schools to help build up interest in computing among teachers and pupils.

15 Attachment - Modules in Mathematics

Applied Mathematics
Automotive Mathematics
Biostatistics & Data Analysis
Business Math and IT
Business Maths for Hospitality
Calculus & Statistics
Calculus & Statistics 2
Calculus 1 Computing
Calculus for Network Eng 2
Calculus, Statistical Analysis
Copy of Maths for Const /Archi
Discrete Mathematics 1
Discrete Time Maths TM425
Engineering Computing 2
Engineering Computing 1
Engineering Mathematics 201
Engineering Mathematics 202
Engineering Mathematics 211
Engineering Mathematics 221
Engineering Mathematics 222
Engineering Mathematics 311
Engineering Mathematics 321
Engineering Maths 101
Engineering Maths 102
Introductory Mathematics
IT & Maths
Management Decision Making 1
Management Decision Making 2
Mathematical Explorations
Mathematics & Structures 2
Mathematics 2 (NMCI)
Mathematics 3(NMCI)
Mathematics 4(NMCI)
Mathematics 5 (NMCI)
Mathematics and Statistics 401
Mathematics for Computing 3
Mathematics for Manufacturing
Mathematics for Science 2.1
Mathematics for Science 2.2
Mathematics for Science 3.1
Maths & Statistics for IS 1
Maths & Statistics for IS 2
Maths for Comms
Maths for Const /Architecture
Maths for Electronic Eng
Maths for Electronic Eng TM325
Maths for Network Eng 2

Numerical Methods 1
Numerical Methods 2
Operation Research
Scientific Computing 1
Statistics & Probability
Systems Analysis
Tech. Math 1 (Maple & C.A.)
Technological Mathematics 311
Technological Mathematics 1
Technological Mathematics 2
Technological Mathematics 201
Technological Mathematics 220
Technological Mathematics 220A
Technological Mathematics 221
Technological Mathematics 301
Technological Mathematics 312
Technological Maths (Nautical)
Technological Maths 1 (C.A.)
Technological Maths 1 (Maple)
Technological Maths 101
Technological Maths 2 & Maple
Technological Maths 2 (Elec)
Technological Maths 2 (Elx)
TM320 Maths for Electrical Eng
TM420 Maths for El Power Sys

16 Attachment - Modules in Statistics

Biomedical Statistics
Business Maths and Stats I
Business Maths and Stats II
Data Analysis for Education
Lean Manufacturing
Management, Stats and Prob.
Mathematics for Engineers 402
Probability & Financial Maths
Probability & Statistics
Probability and Statistics
Process improvement
Research Skills & Statistics
Statistical Calculations
Statistical Quality Control
Statistics 4302
Statistics for Engineering 301
Statistics for Tourism
Technological Mathematics 302

17 Attachment – Selected Extracts from "Monitoring Ireland's Skills Supply –

Trends in Education and Training Outputs – Expert Group on Future Skills Needs"

http://www.skillsireland.ie/media/egfsn-091102-monitoring-skills-supply.pdf

	Levels 1 / 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Levels 9 / 10	Total
General & Combined Programmes	60	970	190	140	110	80	0	30	1,580
Education				10	70	90	1,810	2,410	4,390
Arts & Humanities				1,660	380	1,240	5,400	2,000	10,680
Social Science, Business & Law		450	250	3,580	2,520	2,850	7,740	4,830	22,220
Science				60	210	410	2,280	890	3,850
Computing				310	320	410	980	840	2,860
Engineering & Construction			70	470	6,500	1,930	2,580	830	12,380
Agriculture & Veterinary			60	640	560	300	300	50	1,910
Healthcare			10	6,210	670	940	4,390	2,400	14,620
Services			1,200	1,130	1,900	1,080	600	380	6,290
TOTAL	60	1,420	1,780	14,210	13,240	9.330	26,080	14,650	80,780

Table 17.1 Summary of Further and Higher Education and Training Awards by Field of Education, 2008

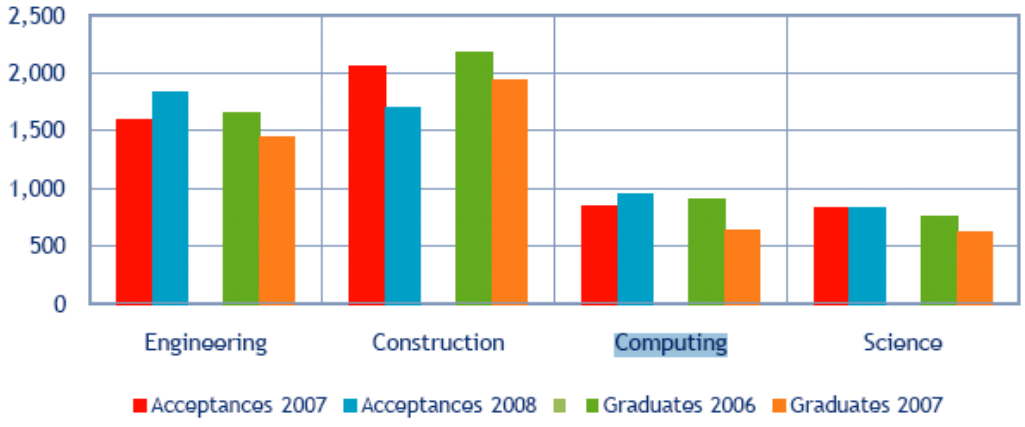

Figure 17.1 Level 7/6 Technology CAO Acceptances and Graduate Output

Computing: the number of acceptances for computing courses increased by almost 13% over the period 2007-2008; this should lead to a moderate increase in the number of

computing graduates in the short-term; the increase however will not be sufficient to counteract the sharp declines observed in recent years.

Computing: the number of acceptances for computing courses increased by almost 13% over the period 2007-2008 which should lead to a moderate increase in the number of computing graduates in the short-term; the increase however will not be sufficient to counteract the 29% decline in computing graduates observed over the period 2006-2007

Although there was a 13% increase in computing course acceptances between 2007 and 2008, the number for 2008 (952) remains below that observed in 2004 (985) – a decline of 3.4%.

Discipline Level 7 / 6	**Acceptances 2004**	**Acceptances 2007**	**Acceptances 2008**	**% Change 2008 – 07**	**% Change 2008 - 04**
Engineering & Manufacturing	1,684 (12.9%)	1,602 (13.3%	1,838 (14.8%)	14.7%	9.1%
Construction	1,995 (15.3%)	2,061 (17.1%)	1,695 (13.7%)	-17.8%	-15.0%
Computing	985 (7.5%)	845 (7.0%)	952 (7.7%)	12.7%	-3.4%
Science (non healthcare)	661 (5.4%)	840 (7.0%)	833 (6.7%)	-0.8%	26.0%
Total Technology	5,325 (41.0%)	5,348 (44.3%)	5,318 (42.8%)	-0.6%	-0,1%
Healthcare	338 (2.0%)	312 (2.6%)	384 (3.1%)	23.1%	13.6%

Table 17.2

Discipline	**2006**	**2007**	**% Change 2006 – 07**
Engineering & Manufacturing	1,654	1,440	-13%
Construction	2,178	1,932	-11%
Computing	900	643	-29%
Science	762	616	-19%
Total Technology	5,494	4,631	-16%
Agriculture / Veterinary	401	445	11%
Health & Welfare	1449	1407	-3%
Total Health, Vet & Agriculture	1,850	1,852	0%
Arts & Humanities*	1,485	1,696	14%
Education	226	155	-31%
Social Sciences, Business & Law	5,095	5,036	-1%
Services	1,855	2,228	20%
Total Other	9,236	9,955	8%
Total All	16,005	15,598	-3%

Table 17.3 Level 7/6 Graduate Output by Discipline, 2006-2007

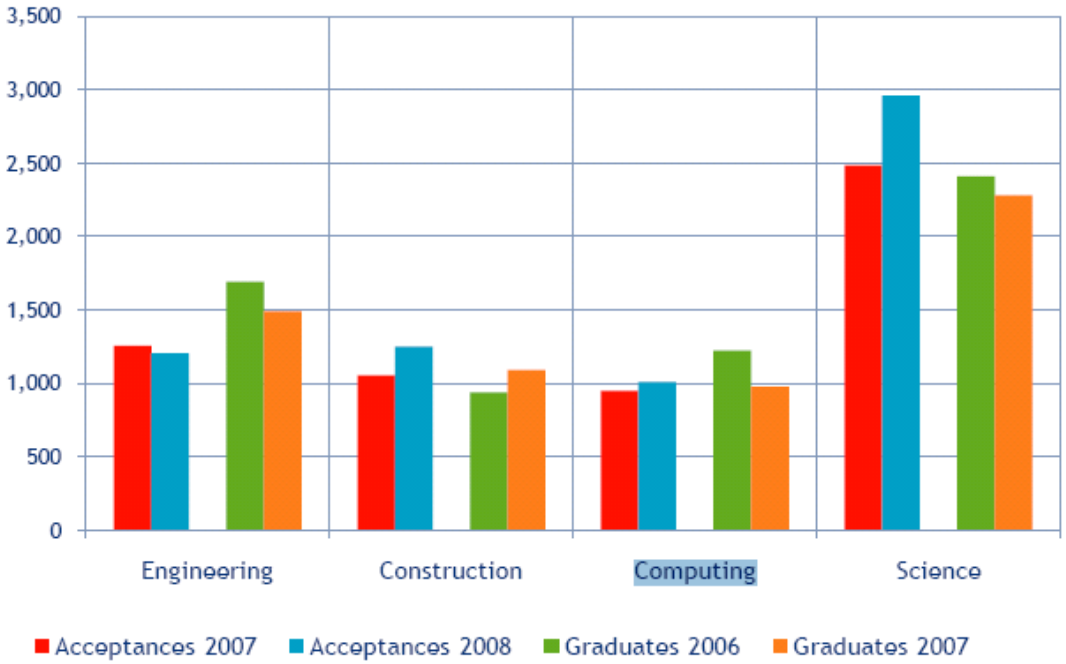

Figure 17.2 Level 8 Technology CAO Acceptances and Graduate Output

Computing: although CAO acceptances in computing increased by 6% between 2007 and 2008 (+59 acceptances), it is unlikely to be sufficient to reverse the downward trend in graduate output observed in recent years.

Computing: CAO acceptances for computing courses at this level have been increasing since 2006; this in turn should counteract, at least partly, the declining trend in computing graduate output in the medium term.

Discipline Level 8	Acceptances 2004	Acceptances 2007	Acceptances 2008	% Change 2008 – 07	% Change 2008 - 04
Engineering	1,171 (5.4%)	1,251 (4.5%)	1,202 (4.1%)	-3.9%	2.6%
Construction	1.031 (3.5%)	1.056 (3.8%)	1.247 (4.2%)	18.1%	21.0%
Computing	889 (3.8%)	946 (3.4%)	1,005 (3.4%)	6.2%	13.0%
Science (non healthcare)	2,594 (10.5%)	2.484 (8.9%)	2.958 (10.0%)	19.1%	14.0%
Total Technology	5,685 (23.3%)	5,737 (20.6%)	6,412 (21.6%)	11.8%	12.8%
Agriculture and Veterinary	274 (1.2%)	327 (1.2%)	380 (1.3%)	16.2%	38.7%
Nursing	1,802 (8.0%)	2,105 (7.6%)	1,969 (6.6%)	-6.5%	9.3%
Medicine	308 (1.4%)	502 (1.8%)	620 (2.1%)	23.5%	101.3%
Dentistry	68 (0.3%)	63 (0.2%)	69 (0.2%)	9.5%	1.5%
Other Healthcare	1,099 (3.8%)	1,223 (4.4%)	1,242 (4.2%)	1.6%	13.0%

Table 17.4 CAO Level 8 Acceptances by Discipline, 2004, 2007 &2008

The most notable changes since 2006 concern a 20% decline in computing, resulting in 243 fewer graduates for 2007 and a 12% fall in the number of graduates in engineering and manufacturing.

Level 8 Graduates	Total 2006	Total 2007	% Change
Engineering & Manufacturing	1,689	1,489	-12%
Construction	939	1,092	16%
Computing	1,219	976	-20%
Science	2,408	2,280	-5%
Total Technology	6,255	5,837	-7%
Agriculture / Veterinary	238	302	27%
Health & Welfare	4,162	4,385	5%
Total Health, Vet & Agriculture	4,400	4,687	7%
Arts & Humanities*	5,374	5,398	0%
Education	1,379	1,811	31%
Social Sciences, Business & Law	7,584	7,740	2%
Services	526	598	14%
Total Other	14,863	15,547	5%
Total All	25,518	26,071	2%

Level 17.5 Graduate Output by Discipline, 2006 & 2007

	2006				2007				
Level 9 / 10 Graduates	**PG Cert / Dip**	**Masters**	**PhDs**	**Total**	**PG Cert / Dip**	**Masters**	**PhDs**	**Total**	**% Change**
Engineering	84	364	139	587	97	362	143	602	3%
Construction	54	195	11	260	51	161	16	228	-12%
Computing	219	575	65	885	167	594	83	844	-5%
Science	188	355	342	885	142	387	356	885	0%
Total Technology	545	1,489	557	2,591	457	1,504	598	2,559	-1%
Agriculture and Veterinary	1	38	23	62	0	29	23	52	-16%
Health & Welfare	1,326	744	106	2,176	1,575	695	131	2,401	10%
Total health, Vet & Agriculture	1,327	782	129	2,238	1,575	724	154	2,453	10%
Arts & Humanities	161	1,331	129	1,621	285	1,608	134	2,027	25%
Social Sciences, Business & law	1,255	3,162	111	4,528	1,294	3,397	138	4,829	7%
Education	1,796	464	28	2,288	1,858	530	20	2,408	5%
Services	104	184	12	300	123	242	11	376	25%
Total Other	3,316	5,141	280	8,737	3,560	5,777	303	9,640	10%
Overall Total	5,188	7,412	966	13,566	5,592	8,005	1,055	14,652	8%

Table 17.6 Level 9/10 Graduations by Discipline, 2006-2007

The number of postgraduate awards in computing declined by 2% between 2006 and 2007; although the number of postgraduate cert/diploma awards in this discipline fell by almost a quarter, there was a 28% rise in the number of PhDs and a 3% increase in the number of master awards when compared to 2006.