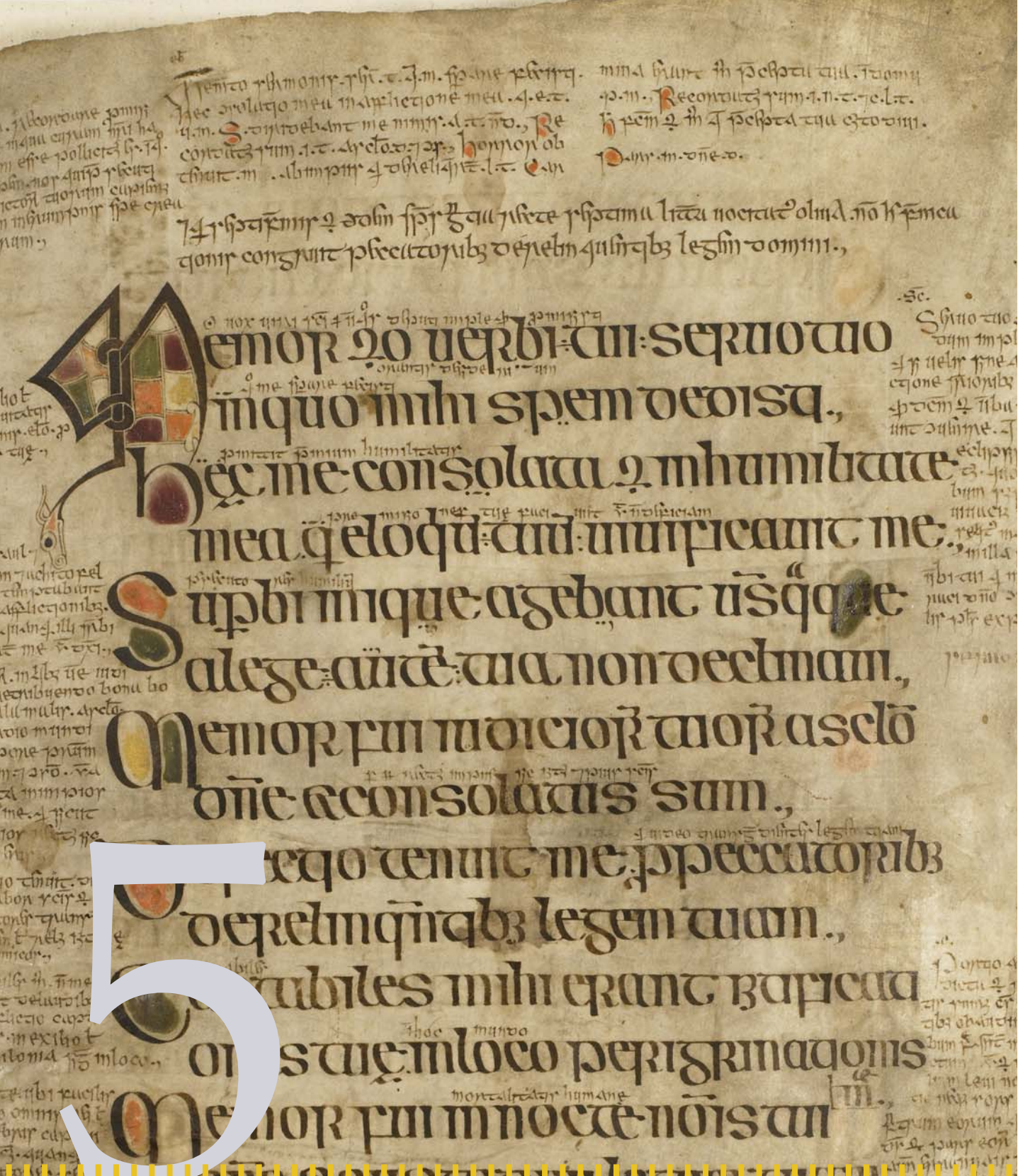


5

Research

5.1. Context and overarching goals

5.1.1. Emerging challenges

At the heart of UCD's research strategy is the ambition to address the challenges that will shape Ireland's future and its role in the wider world. Key national issues include environment, energy, agrifood, health, ICT, financial services and the development of evidence-based policy. These align with many of the current global challenges in areas such as financial risk, energy, food shortage and environment. To address these issues, funding agencies are shifting their resources towards more programmatic research. The US National Science Foundation, for example, has redirected 50 per cent of its funding towards interdisciplinary research. Furthermore, research is experiencing an inevitable churn as major themes fade from importance and new areas emerge faster than ever. In part this churn is driven by technology, which in some cases has been slow to deliver on expectations and in other cases has been rendered obsolete by new developments. This identifies a requirement to develop a strategic approach to information and knowledge management that guides investment in our technology-based programmes and assures both the development of robust and appropriate local computational infrastructures and access to emergent global e-infrastructure (or cyberinfrastructure).

UCD will foster:

- Basic research embedded in strong disciplines
- Creative interdisciplinary programmes that draw on these disciplines to promote new fields of study
- Initiatives that exploit new knowledge to inform public policy and to stimulate economic development in areas of national priority.

The success of the approach is dependent on the strength of disciplines and on individuals who can lead across disciplinary boundaries.

5.1.2. Challenges for Ireland

The UCD Strategy is being developed against a background of unprecedented change. Ireland faces a radical economic reversal and a very uncertain future. The decline in public confidence and the systemic loss of competitiveness in low-end manufacturing industry makes it imperative that Ireland creates new industry, helps existing industry to develop and further develops its attractiveness as a destination for high value-added foreign investment. As Ireland's largest university, UCD will play a major role in the national recovery process with particular emphasis on key areas such as biopharmaceutics, ICT, renewable energy and agrifood, all of which link to priority UCD research themes. This has been recognised in *Building Ireland's Smart Economy*, the government's framework for sustainable economic renewal announced in December 2008. A major strand of the framework, entitled *The 'Ideas' Economy Establishing 'The Innovation Island'* aims to "make Ireland the innovation and commercialisation capital of Europe - a country that combines the features of an attractive home for innovative multinationals while also being a highly attractive incubation environment for the best entrepreneurs in Europe and beyond".

It is equally important in these challenging times that Ireland does not lose sight of its cultural heritage and tradition, retaining its identity, engaging its diaspora and developing its culture as a valuable contributor to economic and social renewal.

5.1.3. Challenges for UCD

UCD is well positioned to address the challenges outlined by government. The previous strategy cycle, 2005/2008, has seen extraordinary growth in research activity in the University. UCD has made substantial progress towards its ambition of becoming one of Europe's leading research-intensive universities and now ranks 33rd amongst universities in Europe (QS World University Rankings 2009 - top European universities). There is an emerging focus on interdisciplinary research that harnesses the diversity of the University and the partnerships we have formed with other academic institutions and industry.

The University's emerging research programmes provide the foundation for a more ambitious and challenging horizon. In recent years, UCD has grown its research programmes in areas such as environment, energy and health, drawing on the rich and unique mix of expertise across its campus. Even with such progress, UCD recognises that it needs to collaborate if it is to compete globally in research and contribute to the emergence of an innovation culture. The key challenge for research at UCD will be to continue to build on the considerable success of the past few years and to sustain its existing programmes in the face of a major economic challenge. This will clearly imply focusing on areas of known strength in times of declining availability of research funding. UCD attracted 26 per cent of the nearly €280 million of research revenues reported by the seven universities in 2006/2007, accounting for 18 per cent of the University's total income. However, recurrent funding for research by all state agencies has been cut in 2010, impacting disproportionately on new grants and resulting in a fall in research income by as much as 40 per cent in the next three to four years. The University must increase and diversify its funding from non-Exchequer sources, including European Union grants and those arising from industry partnerships (now 9 per cent and 6 per cent, respectively, of UCD's recurrent research income).

While we make strong argument elsewhere in this plan for the practical utility and benefit of investment in UCD's research infrastructure and activity, we assert with equal force that this return on investment is dependent on the strength of our core disciplines where knowledge is pursued as an end in itself. The visible achievement of innovative products, services and policies is only possible if built on a broad and deep foundation of scholarship across a wide range of disciplines. In summary, to achieve our targets and realise fully our research potential, UCD must harness all of the disciplines and resources of the University to contribute to the development of an innovation culture in Ireland.

5.2. Objectives

It is critical that UCD continues to put in place a robust research infrastructure to effectively support research initiatives and applications, to grow and develop the research capabilities of our staff and to communicate our outputs and successes to wider stakeholder groups.

In this regard, UCD's objectives over the period of the plan will include the following:

- Continue to develop an academic community of top-class scholars with a vibrant research culture
- Become a leader in translating relevant research findings for cultural, economic and societal benefit.

UCD will:

- Continue to invest in our core disciplines as the bedrock of individual scholarship and postgraduate education
- Create structures to support the development of the major research themes and sub-themes
- Develop new talent as future research leaders through external programmes, effective mentoring and the further development of career pathways and opportunities
- Recruit research leaders and talented young researchers through the SFI Stokes and similar programmes and through UCD's own resources
- Develop seamless pathways from undergraduate to postgraduate to researcher that imbue our teaching with the latest developments in research and discovery
- Build the *Innovation Alliance* with TCD as a key corporate and research priority
- Invest in the infrastructure for research including buildings, technology platforms and ICT
- Promote interdisciplinarity through measures including
  - focus on institutes and centres
  - seed funding for interdisciplinary initiatives
  - provision of undergraduate research opportunities
  - development of the graduate schools
  - design of new facilities
- Diversify our funding base by targeting European Union, US and industry funding
- Develop a knowledge-management system to enhance impact and commercialisation
- Target overheads to successful researchers and academic units
- Develop research support services as a tailored and decentralised system.

5.3. Major research themes

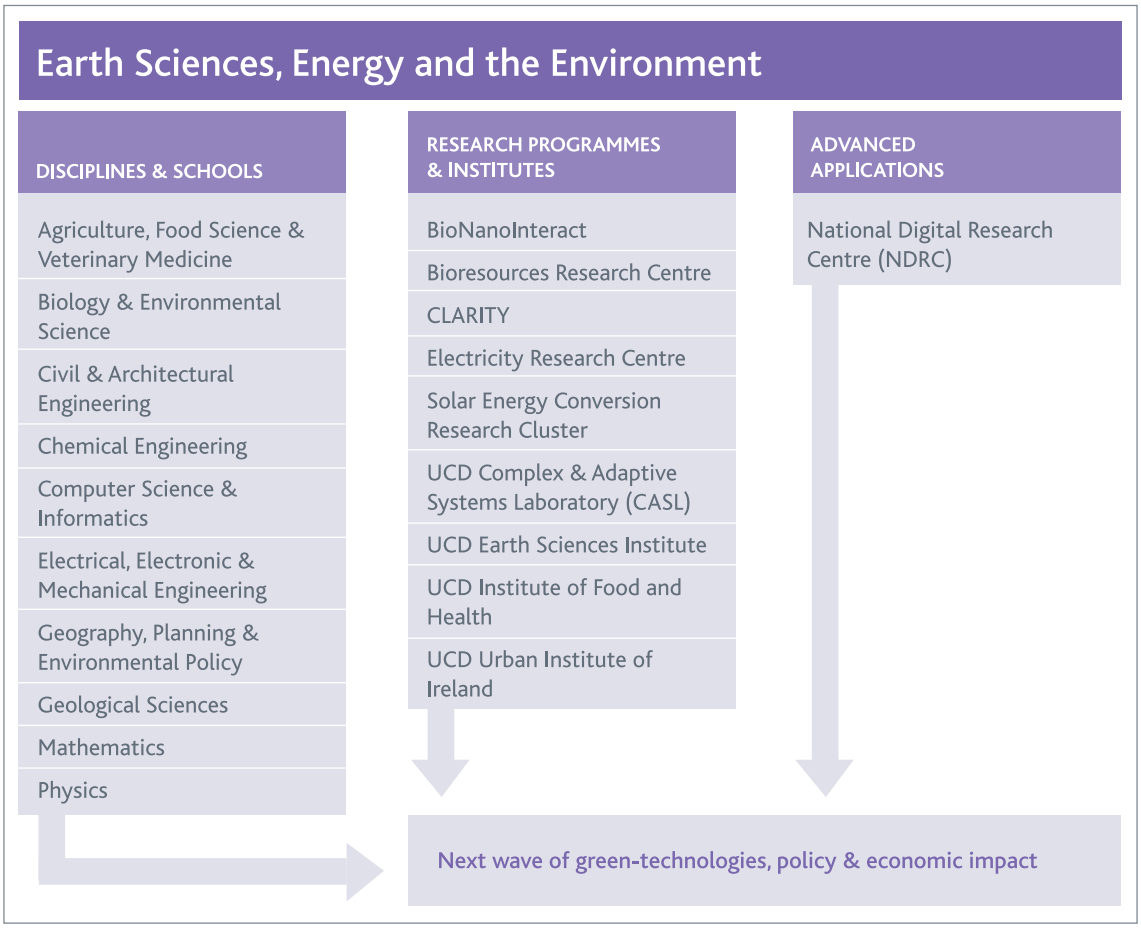
UCD will focus effort and resources on the four major research themes:

1. Earth Sciences, Energy and the Environment
2. Global Ireland
3. Health and Healthcare Delivery
4. Information, Computation and Communications

These major research themes span from basic disciplines and individual scholarship through to large-scale inter-disciplinary programmes and on to more applied research, technology resources and engagement with industry. While these thematic research areas will receive particular attention, UCD academics will be engaged broadly, remaining committed to Newman's ideal of versatility of intellect across our entire range of disciplines in the humanities and the sciences: it is from the richness and diversity of our intellectual efforts within traditional disciplinary boundaries that innovative developments such as those set out below derive.

5.3.1. Earth Sciences, Energy and the Environment

A key objective of the *Building Ireland's Smart Economy* framework is the greening of the Irish economy through "enhancing the environment and securing energy supplies". 'The Smart Economy' is a 'green economy' in that it recognises the interrelated challenges of climate change, environmental resources and energy security. It involves the transition to a low-carbon economy and recognises the opportunities for investment and employment in clean industry. This strategy replaces the expenditure on fossil-fuel-based energy production with an investment in renewable energy and increased energy efficiency, thereby reducing demand, wastage and costs. The strategy provides opportunities for Ireland's economy through innovation of green technologies and protects employment by making Ireland a competitive destination for foreign direct investment (FDI), where industry has access to affordable energy and technologies that enable it to meet environmental obligations.



Resources spanning Earth Sciences, Energy and the Environment

UCD has developed a major capacity in research on energy and the environment, drawing on strong disciplines in agrifood, biology, chemistry, engineering, geology and physics. The University has unique resources in the Irish context in areas such as agrifood, plant biology and experimental atmospheres, computational and simulation science and its industry linkages through major funded programmes. These include CLARITY, the Solar Research Conversion Cluster and a collaborative Competence Centre on biorefining. The theme of Earth Sciences, Energy and the Environment builds on this unique capability to find solutions to key challenges in sustainable energy, climate change and nature conservation which are relevant for Ireland and that contribute to global understanding. The programme has a unique policy dimension through the Urban Institute of Ireland and its collaborations with relevant national agencies. A key goal of the research in this area is to enable achievement of the targets set out in the Government's white paper on energy and Ireland's obligations under international treaties on the environment. It will also enable Ireland to meet future challenges in emerging areas such as nanotechnology. The Earth Sciences, Energy and the Environment theme builds on a number of resources in UCD, including UCD Urban Institute of Ireland, UCD Institute of Food and Health, the nanobiology programme BioNanointeract (an SFI-funded Strategic Research Cluster), the CLARITY CSET, the National Digital Research Centre (NDRC) and UCD Complex and Adaptive Systems Laboratory.

Major areas for research include:

- Earth systems, including atmosphere and climate change, geosystems and water resources
- Energy research, including renewable, clean, secure and sustainable energy, power systems, building technology and economics
- Biosystems, including bioresources, biocomplexity, food and global change biology
- Urban systems, including the built environment, transport and geographic information systems
- Environment and energy innovation, including policy development.

The theme will undoubtedly evolve, harnessing convergent technologies to provide unique solutions in such emerging areas as nanotoxicity, ubiquitous monitoring and environmental bioprocessing.

5.3.2. Transforming the study of Ireland and the Irish worldwide

UCD has Ireland's most diverse and most developed capacity in the humanities and social sciences. This is directed at understanding our past, engaging with the present and innovating for the future. The theme Global Ireland builds major research programmes across a spectrum of inquiry ranging from archaeology to the behavioural social sciences. The unifying feature is the focus on Ireland and the shared commitment to comparative method and contextual analysis. The comparative perspectives underpinning the Global Ireland research theme include North-South, Anglo-Irish, European Union, Irish-American and the Irish diaspora, post-colonial and global. The European and global perspectives are particularly important in coming to grips with the contemporary crisis. The theme Global Ireland builds on three major areas of strength: the UCD Geary Institute, the UCD Humanities Institute of Ireland (HII) and the UCD John Hume Institute for Global Irish Studies.

The UCD Geary Institute has a national and international reputation in microeconomics, quantitative social sciences and behaviour, leveraging the concept of Ireland as a unique laboratory for evidence-based policy formation.

The major research themes within the UCD Geary Institute will include:

- Behavioural aspects of health and welfare
- The integration of economics, developmental psychology, epigenetics and biosocial sciences to focus on issues of child health, education and parental investment and on the role of the family
- Analysis of political attitudes and behaviour and how they are shaped by context.

Resources spanning Global Ireland

Working with national and international academic, agency and industry partners, the UCD Geary Institute will contribute to an innovative policy environment that can respond flexibly to a rapidly changing European and global economy.

The UCD Humanities Institute of Ireland (HII) has served to establish UCD as Ireland's pre-eminent centre for graduate formation and research in the humanities, with a particular emphasis on thematic interdisciplinary research initiatives.

Since its inception in 2002, it has:

- Hosted over 50 conferences and 100 seminars
- Achieved a 95 per cent completion rate for humanities PhDs
- Developed an international reputation through the quality of its peer-reviewed publications.

Over the period of this plan, the HII programme will focus on 'Society, Culture and Change' and bring this to bear on the overarching Global Ireland theme.

The UCD John Hume Institute for Global Irish Studies brings together the humanities and the social sciences, adopting a radical interdisciplinary approach to transform the study of Ireland and the Irish worldwide. Over time, Ireland has been exposed to successive waves of external influence. Similarly, successive generations of Irish men and women have contributed to the transformation and development of societies across the globe, from Argentina to Zambia. These are best understood in comparative and international contexts rather than as a single-country case study. UCD is building the capacity to conduct integrative research on Ireland and to deliver associated innovative teaching and learning programmes at all levels.

This work is founded upon the University's unique resources and archival collections, which include:

- The Delargy Centre for Irish Folklore collection
- The Irish Franciscan Archive
- A growing collection of political archives and ministerial private papers
- Diverse library special collections that span the 16th though to the 20th century.

Resources established during the previous UCD five-year strategic planning period include:

- Digital collections available through the Irish Virtual Research Library and Archive (IVRLA) and the Irish Social Science Data Archive (ISSDA)
- Additional resources at the National Digital Research Centre.

While work on these new virtual resources has focused to date on development of technological infrastructure and acquisition of critical masses of data and information, the current strategic plan calls for further development of services that enable their content to be integrated with computational workflows and that provide new interfaces that enhance their value and extend their impact. It also calls for planning to assure their sustainability by embedding them in the University's organisational fabric.

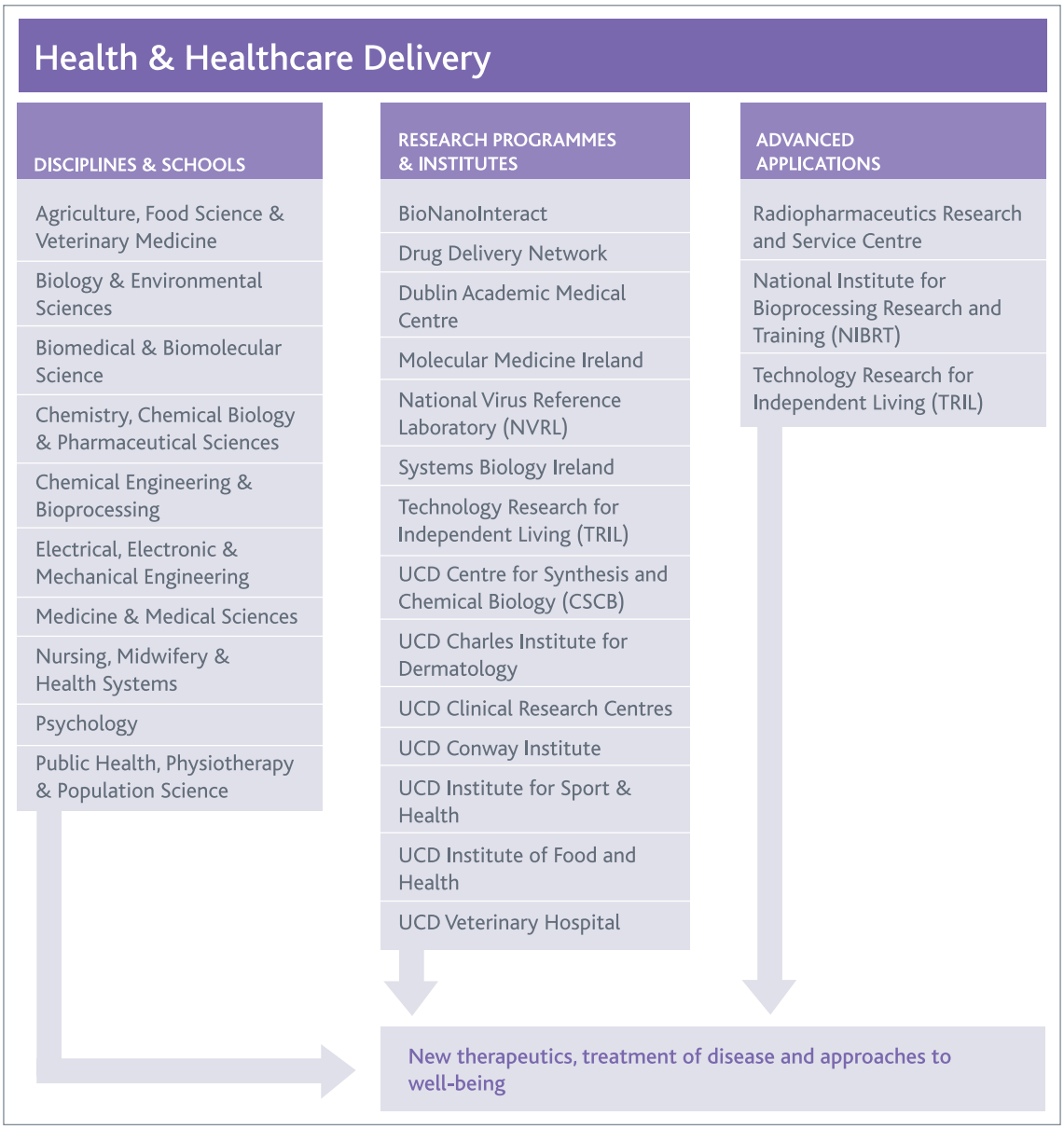
UCD will build on the response to existing initiatives funded under Programme for Research in Third-Level Institutions (PRTLI) cycle 4, including work on:

- The Footprints of Ireland
- Heritage and Landscape and Irish Identities
- Cultural and Linguistic Expression
- Towards 2016
- The Irish experience of Conflict Resolution.

5.3.3. Health and Healthcare Delivery

Developments in physics, chemistry, computer information and engineering provide unprecedented opportunity in the life sciences, not least in making available technologies that allow an unbiased interrogation of cell systems and whole organisms. The intersection of these disciplines and, in particular, the underpinning of engineering will have a profound effect on our ability to address major challenges in animal and human health.

UCD is uniquely placed to contribute to our fundamental understanding of disease mechanisms and to translate these findings for the benefit of society. Our biomedical programme is focused on several major challenges that are impacting health nationally and internationally, such as diabetes, infection, reproductive biology, skin disease and neurodegeneration. Our focus is not solely on disease but on providing solutions that enable wellness, for example through our Food and Health Programme and our Technology Research for Independent Living (TRIL).



Resources spanning Health and Healthcare Delivery

We will further develop this interdisciplinary approach by developing an integrative biology programme across science and engineering, strengthened by an underpinning in computational science and informatics. We will harness the wealth of expertise and newly funded programmes to explore innovations in nanomedicine, stem-cell therapeutics and biopharmaceuticals. We will build on our expertise in life sciences and humanities to develop innovative programmes in population health, in emerging areas such as epigenetics applied to the social sciences and in new approaches to behavioural economics. We will work through collaboration with TCD through the *Innovation Alliance*, to create world-class programmes in complementary areas and harness these for social and economic benefit.

In particular, the prioritised programmes within this theme will:

- Contribute to the delivery of a world-class health service within our affiliated teaching hospitals
- Contribute to international development
- Dovetail with Ireland's pharmaceutical and medical device industries
- Underpin undergraduate and postgraduate programmes in health and biomedical sciences.

The Health and Healthcare Delivery theme builds on unique resources at UCD, including:

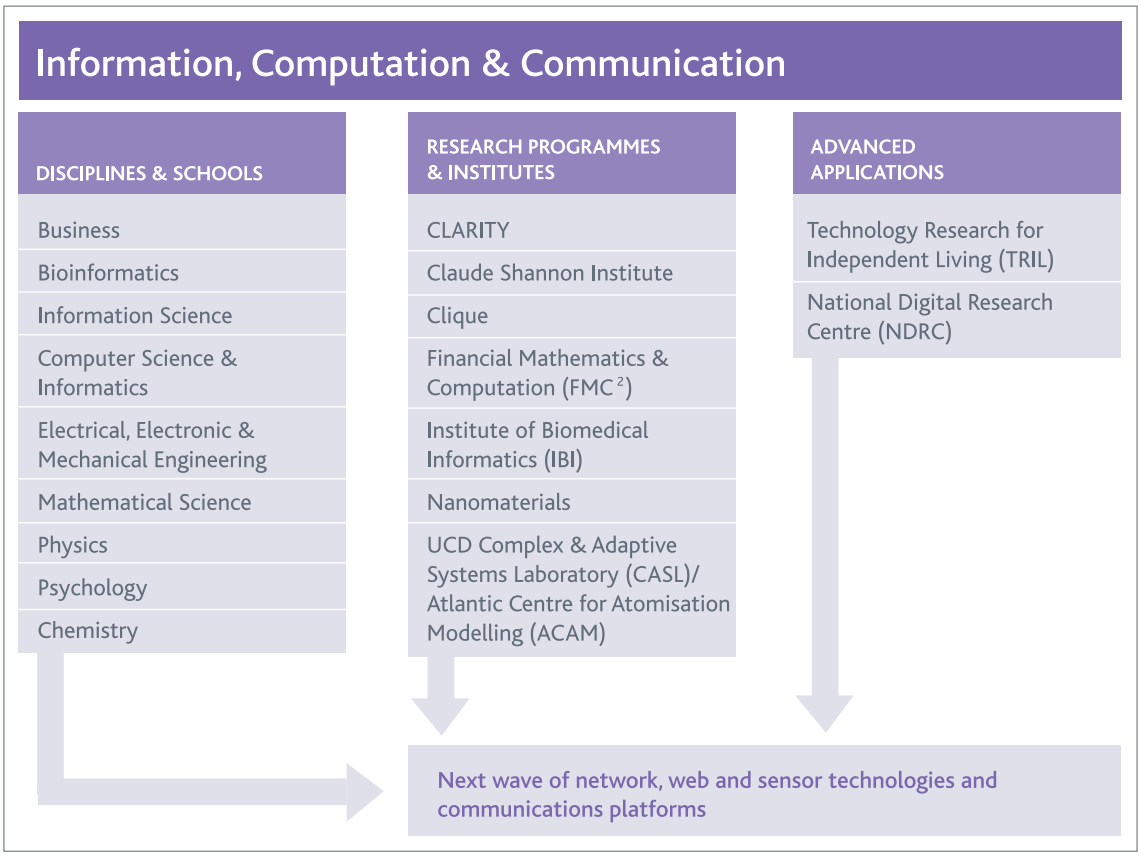
- UCD Charles Institute of Dermatology
- UCD College of Life Sciences Integrative Biology Programme
- UCD Conway Institute of Biomolecular and Biomedical Research
- UCD Centre for Synthesis and Chemical Biology
- UCD Institute of Food and Health
- Systems Biology Ireland
- Technology Research for Independent Living (TRIL)
- The National Institute for Bioprocessing Research and Training (NIBRT)
- Dublin Academic Medical Centre, which brings together the resources of UCD, St Vincent's University Hospital, Mater Misericordiae Hospital and other UCD-affiliated teaching hospitals
- The National Virus Reference Laboratory
- UCD Clinical Research Centres at affiliated teaching hospitals
- UCD Veterinary Hospital.

A critical foundation for the development of this theme has been the integration of areas such as biomolecular and biomedical science, food science, agriculture, human and veterinary medicine, performance science and public health in a unified academic structure: the UCD College of Life Sciences. A second critical enabler is the focusing of all biomedical research through the UCD Conway Institute. A third critical factor has been the creation of strong translational research links with UCD's major affiliated teaching hospitals and through the ground-breaking strategic alliance that is Molecular Medicine Ireland.

Major programmes within this theme will include food and health, biopharmaceutics and pharmacological science, translational medicine, bioengineering and public health.

5.3.4. Information, Computation and Communications

Science and engineering in the 21st century are data-driven and computationally intensive. From the life sciences to economics, from climate and environmental modelling to social sciences, and from neuroscience to communications, it is clear that modern scientific enquiry requires a deep understanding of informational relationships and dynamics achieved through the computational and mathematical properties of the systems themselves. UCD's opportunity in this area derives in the first instance from the existence of the University's major cognate research strengths. Of equal importance, however, is the identification of information, computation and communications as being of major strategic importance to Ireland's ambition of creating a knowledge economy and, crucially, a judgment that it is the area where the largest skills gap exists at postgraduate level.



Resources spanning Information, Computation and Communications

The theme builds on major UCD investments, resources and collaborations, including:

- UCD Complex and Adaptive Systems Laboratory (CASL)
- Claude Shannon Institute for Discrete Mathematics, Coding and Cryptography
- Institute of Biomedical Informatics
- CLARITY (formerly, Adaptive Information Cluster), creating the sensor web
- NDRC.

UCD's unique capability in this area was enabled by the inclusion of engineering, mathematical and physical sciences and computer science in a unified academic structure: the UCD College of Engineering, Mathematical and Physical Sciences. Another critical enabler has been the creation of the CASL, a new facility that brings together 200 scientists and postgraduate students from mathematics, engineering, computer science, biology, bioinformatics and finance.

The CASL underpins the emerging research and educational programmes, such as systems biology, wireless technologies, digital media and bioengineering, and provides access to unique resources, including high-end computing and the UCD Data Centre.

5.4. Key metrics and performance indicators

UCD will assess its progress against the objectives set out above using the following metrics.

- Peer-reviewed (quality) publications per staff member: publications in a given year per staff member
- Number of publications in top-ranked outlets (top 10 per cent of journals in a given discipline or top-ranked book and monograph publishers)
- Percentage of research-active staff. Taking into account disciplinary norms, a research-active academic will have regularly supervised postgraduates, published quality work in his or her field of expertise and/or attracted appropriate extramural research funding. It is targeted that by 2014, 90 per cent of UCD academic staff will be research active.
- Competitive peer-reviewed extramural research awards: success with major Irish and international funding programmes, measured in terms of market share.