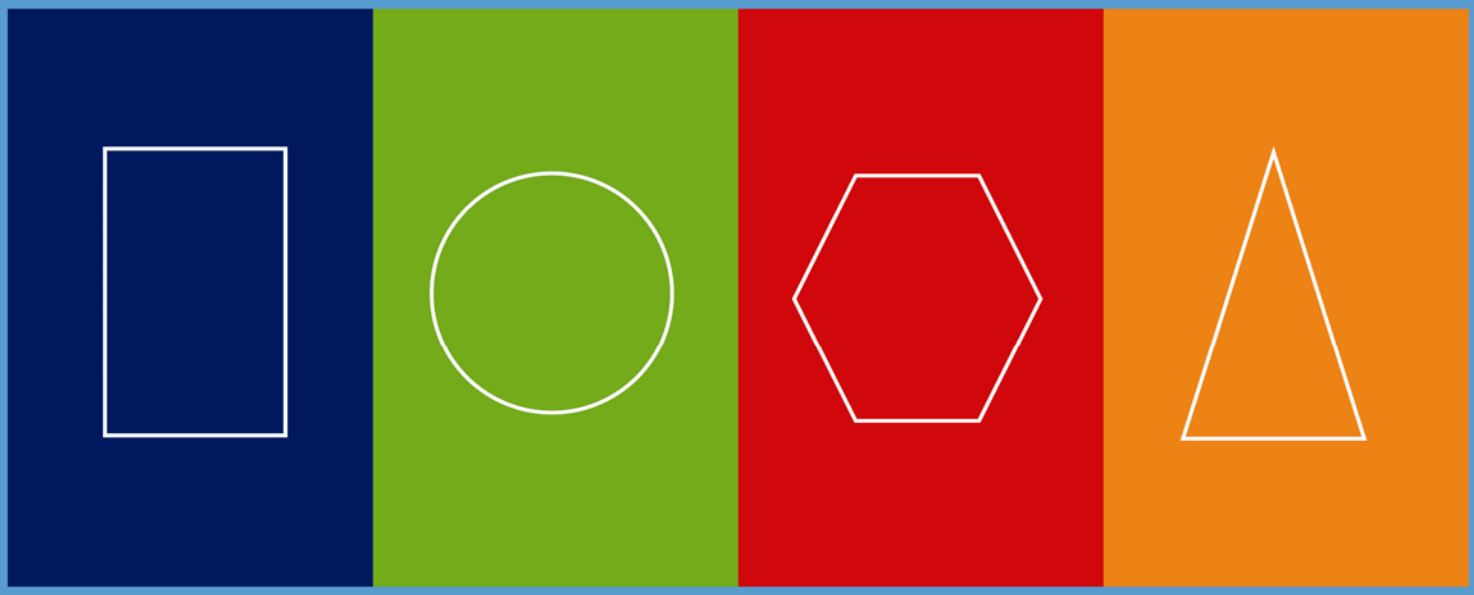


Skills in Creativity, Design and Innovation

November 2009

Forfás

Expert Group on Future Skills Needs

Table of Contents

Foreword

We are in a period in our economic history when, as never before, we need to focus on how we can marshal our national educational advantages, our skills and our innate attributes of character and personality to best effect to keep Ireland on a path of job creation, matched with improved competitiveness. In that context, the publication of this report could hardly be more timely.

The concepts of creativity, design and innovation as essential ingredients for economic success are well established and accepted. However, they can sometimes seem to be a bit nebulous in terms of what they actually mean in the reality of the workplace. Some may associate creativity, design and innovation with scientific laboratory work, whereas others will think more in terms of the creative arts. In short, different individuals and bodies often have differing interpretations of what these concepts actually entail.

What we have sought therefore with this report is first to define what the terms creativity, design and innovation mean specifically in the enterprise context and then to demonstrate that their application has potential direct relevance across the full range of enterprises and occupational activities. The report grounds these concepts further by relating them to the real life education and skills we believe are the ones best suited to fostering the kind of creative and innovative ways of working that we need here right now.

We hope that, through this approach, theoretical concept has been linked to practical application in a way that is useful for everyone who has an interest, either professional or personal, in what is involved.

This report dovetails neatly with the Government's strategy for Building a Smart Economy, particularly in its objective of building an Ideas Economy and, in the process, of establishing Ireland as the "Innovation Island". There are four main points I think we should take from the report:

1. What we are recommending here is a sharpening of the strategic focus of existing programmes to maximise their impact on productivity through creativity and innovation rather than any new shift of direction. The broad thrust of education and skills policy in Ireland is already going in the right direction.
2. It is important that, in addition to Science, Engineering and Technology, we are fully aware of how other disciplines, for instance business studies, can contribute in our quest to become the "Innovation Island".
3. The role of design can now be a significant factor for companies that are seeking the all-important point of differentiation that makes their product or service a competitive success.
4. The capacity of being able to work effectively with others from across a wide range of disciplines is a feature of the most creative and productive individuals in an enterprise context. In practice, in a learning environment therefore, this should involve engagement in collaborative cross-disciplinary projects as much as possible.

Una Halligan

Una Halligan
Chairperson, Expert Group on Future Skills Needs

Executive Summary

Introduction

Ireland is at a cross-roads in terms of its economic development. The current recession has only accentuated the need for innovation and productivity growth. This is recognised in the Government plan Building Ireland's Smart Economy - A Framework for Sustainable Economic Renewal[1] one of the key pillars of Ireland's response to the current economic difficulties. One of the main action areas within this is "Building the Ideas Economy – Creating the 'Innovation Island'".

However, turning the intention to innovate into international competitive advantage and renewed economic growth will be challenging, as Ireland is facing a competitive squeeze from overseas competitors. While Ireland is investing heavily in boosting productivity through investing in skills, research, infrastructure and company development, most other countries are behaving similarly. Countries that we now think of as low cost competitors, such as China, India and Brazil, are not aiming just to occupy the low and medium value added positions in the world economy that Ireland and other developed countries are vacating. They are aiming to develop much the same sort of high-added value knowledge economy that we are.

In the past, Ireland's outstanding economic performance has come out of a very distinctive positioning relative to other countries – with a strong supply of skills, English language, low corporate taxation and low costs relative to other politically stable participants in the global economy. Now, we are jostling for space in a global economy in which all developed and actively developing participants are aiming for much the same broad positioning.

In a world in which innovation is critically important, we can derive advantage from competing on our differences, whether these are cultural, or result from superior insight into particular markets, or from a particular expertise in applying technologies, or from specialist scientific, technological or business expertise. Ireland's unique economic, cultural and social history has given us a fund of differences that we can leverage into superiority in creativity and innovative capability in many product-market niches if we make the effort, and invest in the capabilities and skills we need.

Much of Ireland's strategy for driving innovation has already been mapped out, through actions across a broad range of policy areas, summarised by the Department of Enterprise, Trade and Employment and Forfás in Innovation in Ireland (2008), and this report builds on that work.

In addition, the Expert Group have already commented on the skills needs of specific industries and specific occupations – in particular, the Expert Group has regularly reported the need to enhance the stock of people with skills in science, engineering and technology, and on the need for skills in a range of business areas. In the main, these are the key specific specialist skills required for innovation. The Expert Group has also put forward its views on generic skills, upskilling and lifelong learning, all of which contribute to creativity and capability to be innovative[2].

1 Department of An Taoiseach, 2008

2 Tomorrow's Skills: Towards a National Skills Strategy, EGFSN, March 2007

This report takes the need for both skills in the specialist areas addressed by earlier reports, and for lifelong learning, as established, therefore, and addresses:

- The complementary skills needed by people with specialist skills to enable them to be creative, and to perform effectively as innovators;
- The skills in design that are required, whether among professional designers, or among people from other specialisms;
- The contribution that other specialist skills in the arts, humanities and social sciences can make to creativity and innovation; and
- Further measures required to develop the skills required for innovation in the workplace.

While skills relating to specific occupations and industries are often important for innovation, this report looks at cross-cutting skills that apply across broad swathes of occupations and across many industries. The scope of this study is limited to the requirements of the enterprise sector but the Expert Group is fully conscious that there are many ways in which the application of creativity, design and innovation are equally essential if the public sector is to be responsive to current service delivery needs. This study makes reference to the significance of a user-centred approach throughout, and the Expert Group notes that the OECD review of the Irish public sector has similarly pointed to the need for a 'citizen-centred' approach to service delivery. The implementation of the OECD review recommendations may provide a timely opportunity to take into account some of the relevant findings of this study.

Report Structure

This report is laid out in four main chapters, each of which is summarised briefly below.

Chapter 1 outlines exactly what the Expert Group mean by the terms creativity, design and innovation, and examines the relationship between CDI and productivity. Ireland's performance under a number of internationally measurable metrics is also considered.

Chapter 2 outlines how the concepts of creativity, design and innovation can actually be related to definable skills and competencies. This chapter also provides an overview of the sectors and occupations where such skills are required.

Chapter 3 provides an overview of how CDI skills are developed in Ireland through both the formal education system and through enterprise-based learning.

Finally Chapter 4 sets out the Expert Group's conclusions in relation to Ireland's need for CDI skills and proposes a number of recommendations designed to address this need.

Chapter 1: Context

This report is concerned with creativity, design and innovation in a business context, and so it uses definitions that are relevant to the business context. Throughout this report, the Expert Group understands creativity, design and innovation to mean the following:

- **Creativity** is imagination applied to the purpose of creating economic value. Most creativity is about finding ways to combine existing ideas to do something new.

- **Design** is the process of moving from an initial creative idea to developing a new or changed product, service or process that can be brought to market or implemented internally within a business.
- An **innovation** is change that creates economic value. This is generally through creating a new or improved product or service; improving the way a business operates internally; or changing the way the business relates to the business system of which it forms a part to bring greater value to its customers.

CDI and Productivity

Skills in creativity, design and innovation are key drivers of productivity improvement – significant productivity improvement arises from new or improved products, services and business processes, which allow businesses to create more value out of the efforts of each worker.

Innovative capability is certainly not the only driver of productivity growth. Other factors, such as infrastructure, competition, labour market flexibility and access to capital also play a role. However, it would appear that a highly innovative economy may experience productivity growth of 1 percent to 2 percent per annum above that experienced by economies that are significantly less innovative. Over time, advantages of this magnitude turn into major gains in competitiveness, and significantly greater economic well-being.

Complementing the general economic impact of creativity, through improvements in innovation and hence productivity growth, creative industries offer particular significant potential for economic benefit. Irish exports of creative services totalled $871m (€712m), with just over half made up of R&D services in 2005, compared with imports of $4,550m (€3,720m), almost entirely made up of R&D services[3]. This primarily reflects fees for intellectual property.

Internationally, there is also an increasing policy focus on leveraging design as a driver of innovation. Experience shows that the development of a design function allows jobs to be retained in developed countries, offsetting the effect of high costs. This is, for example, reflected in the UK's Cox Review of Creativity in Business (2005) and the UK Government's subsequent report, Creative Britain – New Talents for the New Economy (2008). It is also reflected in an increasing focus on design in countries as diverse as Denmark (generally recognised as a design leader), Australia, Taiwan and China.

Ireland has made some limited moves in this direction, with support for design now being a frequent feature of Enterprise Ireland's company development supports, and with the recent establishment of the Centre for Design Innovation, based at Sligo Institute of Technology. These appear to be positive first steps towards developing an effective design strategy for Ireland.

3 United Nations, Creative Economy Report 2008

Irish Innovation Performance

Ireland actually performs strongly under a number of innovation headings. In the most recent period for which comparable statistics are available, Ireland ranked 7th in the EU for the share of its companies engaged in innovation[4]. Ireland also performs well on a number of other fronts, and is notable for having:

- A high incidence of innovation generally;
- A high incidence of organisational innovation;
- Heavy public investment in assisting firms to innovate;
- Substantial technology exporting industries, which include significant Irish-owned operations, and significant innovative activity, but in which exports are primarily based on the transfer of innovations to Ireland, much more than on Irish-based innovation; and
- Fairly good levels of youth education.

However, while the prevalence of innovation in Ireland is relatively high, broader measures of Irish innovation capability indicate that the country is actually fairly average, and that Ireland cannot be considered an innovation leader amongst other developed countries. In particular, Ireland performs poorly in terms of:

- Low adoption of product innovations invented by others (while being fairly typical on adoption of product innovations invented in-house); and
- Low business investment in ICT.

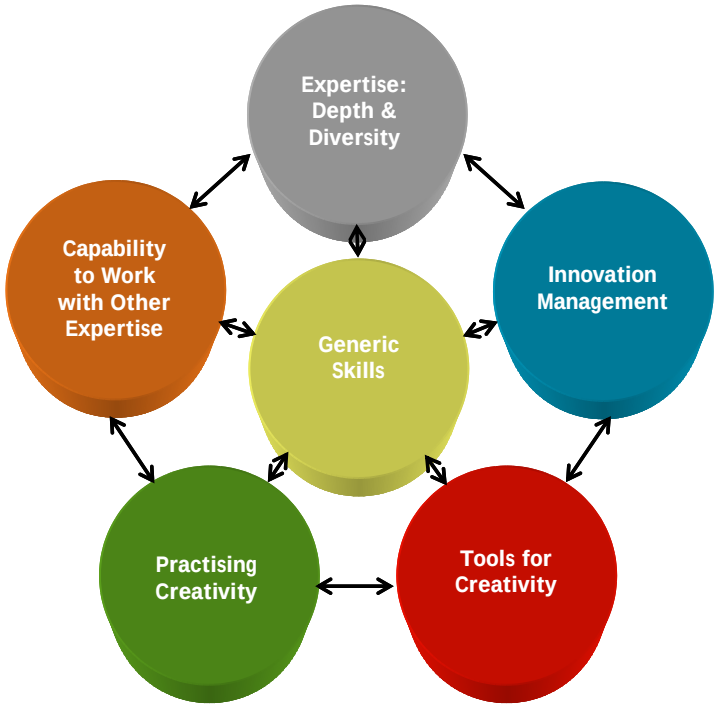
Chapter 2: Skills in Creativity, Design and Innovation

Skills in Creativity

It can be difficult to think of creativity, or "applied imagination", as a skill. However, while the spark of creativity itself is difficult to pin down in skills terms, it is surrounded by identifiable and definable skills that are necessary for creativity. Moreover, while creativity itself cannot be taught as a simple procedure, it is possible for people to learn to do it better. There are six types of learning required in order to engender creativity in an organisation, and these are illustrated in Figure E.1 below.

4 CSO, Community Innovation Survey 2004-2006.

Figure E.1 Six Types of Learning Required for Creativity



Each of the skills shown above is explained in greater detail in the main report, however in summary:

- *Generic Skills* are required to enable people to be meaningfully creative in a business context. Skills in areas such as problem solving, information processing and critical thinking are fundamental to exercising creativity. Skills in areas including communication, teamworking and working with others are necessary because business creativity is usually the outcome of an interactive process.
- *Expertise* allows individuals to contribute to thinking clearly about a problem, and to contribute to generating and evaluating ideas about solutions.
- *Capability to work with other sources of expertise* is important since it is very unusual in a business context for a single person to be the most expert in the domain, the relevant technologies and the business aspects of a problem. Prospects for a creative solution are usually enhanced by interaction with others who have relevant expertise.
- An understanding of the *Tools for Creativity* or the techniques that offer people frameworks to help them think through a problem, and processes to go through to generate creative ideas are the fourth element of a creative skill set.
- *Practising Creativity* is the fifth prerequisite for business creativity - the more practice that people have at being creative, the more creative they are likely to be.
- *Innovation Management* is the sixth and final requirement for business creativity. The approach that businesses take to managing innovation has a major impact on the creativity of their staff, individually and in total.

Skills in Design

In the interviews undertaken for the study, a variety of views were expressed as to what skills and qualities are central to the role of a designer. The description here is a composite based on these interviews.

- Almost all designers need a range of **technical skills** that are appropriate to their design discipline;
- All designers need an understanding of the **language** of the area in which they are working, a language which is usually more about the visual and physical expression of ideas than about verbal or written communication;
- All designers need a high level of **creativity;**
- A strong emphasis on understanding the **user experience**, and applying this to design, is important;
- An **understanding of the market** for what is being designed is critical. Design is a close-to-market discipline, in which people have to understand the market for the product or service they are designing, or the market for their own services, or both;
- Design is a profession in which **T-shaped skills**[5], allowing its practitioners to work effectively with others, are important; and
- In some cases, the role of the designer goes beyond being an effective team worker, to a **leadership** role.

Skills in Innovation

There are four main types of innovation that directly create value:

- New and improved products, once they are bought by customers;
- New and improved services, once they are bought by customers, either by themselves or bundled with products;
- Changes in the way the company relates to the business system of which it forms a part that bring greater value to the business from its customers; and
- Changes to internal processes and other characteristics within a business that improve its economic performance, whether through creating greater value for customers in terms of products, services and business system, or through increasing internal effectiveness and efficiency.

The first three of these rely on customer behaviour. If customers do not respond, no value is created, and no innovation has taken place, no matter how great the internal upheaval within the business. The fourth relies on internal changes within the business. If the business does not change in a way that makes it more valuable, then, again, no innovation has taken place.

5 The vertical leg of the **T** refers to having an in-depth knowledge of an area. The horizontal bar of the **T** refers to having the capability to work with other sources of expertise.

There is a strong tradition, in Ireland and internationally, of associating innovation with disciplines in science, engineering and technology, to the exclusion of other disciplines. However, there is an increasing international acceptance that this oversimplifies matters, and that disciplines in the arts, humanities and social sciences also have important roles to play. The literature places a particular emphasis on the role of design, but a broader range of disciplines from the humanities, arts and social sciences can also contribute. Skills in business disciplines are particularly important.

Occupations and Industries

The report reviews what skills in creativity, innovation and design are required across different types of occupations, and across different industries. It establishes a two-dimensional framework, based on five types of occupation and five types of industry.

Seen from an innovation perspective, we observe five broad types of **occupational** role:

i. **Creatives** are designers, artists, copywriters, photographers, architects, film occupations, illustrators, performers, writers, composers and people in similar roles. It is primarily designers who cross over to contribute to innovation outside the creative industries.

ii. **Professional innovators** are those people whose core job is to contribute to innovation. They include engineers, technologists and scientists working on design, development and research. They also include many people in business roles concerned with innovation including product managers, strategy professionals, business analysts, business leaders, and many marketers, as well as behavioural scientists involved in innovation.

iii. **Sporadic innovators** are the large number of people in managerial and professional roles who have a core job that take most of their time which is more about keeping things running than about innovation. As a part of this, they engage in creative problem solving from day to day, the cumulative effect of which is usually to drive progressive improvement. In an organisation that innovates effectively, they will also have bigger responsibilities to innovate within their own domain, and to work for innovation with others across the organisation, but their engagement with this is likely to be sporadic, rather than constant. Sporadic innovators often have difficulty in carving out enough time to contribute to innovation, in the face of day-to-day operational pressures.

iv. **Creative problem solvers** are people in roles that are mainly about diagnosing problems and troubleshooting. Typical occupations include test laboratory scientists, many computer operations roles, engineers and technicians responsible for keeping production lines going, medical clinicians and quality assurance staff.

v. **Innovators through work organisation** are people whose core job is routine, and who might not have had a role in innovation in the past. Increasingly, however, businesses seek to get these employees involved in innovation through structured improvement processes, ranging from suggestion schemes to highly organised team-based improvement initiatives. For these people, their contribution to innovation tends to come mainly through participative forms of work organisation, such as those now being promoted by the National Centre for Partnership and Performance.

In addition to being relevant across all occupations, innovation is relevant across all industries. As with occupations, in a relatively short study such as this, it is not feasible to analyse every industry for the innovation-related skills it requires. Instead, we look at groupings of industries. Seen from an innovation perspective, we observe five broad types of business:

i. Creative businesses, whose outputs range from fairly pure cultural expressions such as film, television and art, through the application of cultural expression for other business purposes, such as with advertising, digital media, and most graphic design and architecture, to deep involvement in innovation in other sectors, such as with product design businesses;

ii. Businesses whose outputs are largely customised, relying on specialist skills to produce customised outputs (consultancy and investment banking, for example);

iii. Businesses whose outputs are largely customised, but where the customisation is largely systematised, or dependent on other industries for creativity and design (e.g. construction);

iv. Businesses producing largely standardised outputs, in which professional innovators account for a substantial share of all employment (software companies and pharmaceutical companies, for example); and

v. Businesses producing largely standardised outputs, in which professional innovators account for a modest share of all employment (most retailing and some manufacturing industry, for example).

Of course, the boundaries between these classifications are blurry, but they form a useful basis for discussion of skills needs. At company level, an innovative company is one that develops, and successfully brings to market, new and improved products and services. It also continually improves its internal working processes in both small and big steps. To achieve all of this, a company must:

- Have a clear strategic vision of what it is trying to achieve, where it can attain and sustain competitive advantage, and broadly what it needs to do to achieve this.
- Be good at innovation management, empowering, resourcing and rewarding its employees to be creative and innovate in ways that further the company's objectives.
- Involve most or all of its employees in innovation, in one way or another.
- Bring a diverse range of backgrounds and experiences together to solve problems and to innovate, cutting across organisational boundaries. It is good at bringing together business, technology and user perspectives to creative ideas for innovation, to turn them into inventions, and to commercialise inventions into innovations.
- Be open to the world outside the business; is good at understanding user needs and wants; and is good at finding, absorbing and leveraging ideas created elsewhere.
- Have deep expertise that gives it a base of understanding that it needs to be creative and innovate.

The sort of people an innovative company needs are:

- Leaders who are good at setting a strategic direction, can establish an innovation-friendly culture, and who are good at innovation management;
- Employees at all levels who have strong generic skills, particularly in communications, teamworking and problem solving, and who more generally have the skills required to cooperate with others who have complementary skills;
- People with a good understanding of how to apply relevant technologies, with skills in application of information technology being required almost universally, and skills required in other technologies depending on the specific nature of the business;
- People with a good understanding of the market, both in broad aggregate terms, and in terms of the specific needs and wants of users of the product or service; and
- People with a strong grasp of business: how to commercialise a product or service, and how to leverage this to build a strong, profitable and sustainable business.

Chapter 3: Developing CDI Skills in Ireland

The skills of the Irish workforce in creativity, design and innovation are innate to an extent, but are also heavily influenced by their educational and working background, and their life experiences. This chapter provides an overview of the manner in which CDI skills are imparted to people in Ireland through participation in education and workplace learning.

Primary Education

Based on the interviews undertaken for this study, and from the Review of the Primary Curriculum, it is generally believed that Irish primary education is essentially on the right track to prepare students to be creative and innovative. Overall, the primary system is seen as being good at opening students' minds, developing their creativity, preparing them to work collaboratively and teaching them to learn independently. Some interviewees highlighted resourcing issues that they say impact negatively, such as limited access to ICT resources, and by slowing the adoption of new teaching approaches.

Second Level Education

There are serious problems with the way in which second level education impacts on the creativity and innovation capability of Irish students. These problems have a history of being quite intractable because of the influence of public examinations.

The National Council for Curriculum and Assessment (NCCA) appears to have grasped the extent of the challenge that this poses, and is moving forward with what appears to be a coherent strategy to tackle it. The NCCA deserves support on this, and it is important that the process should not be allowed to be slowed by defence of the status quo, by an excessively tight approach to funding of initiatives, or by over-reaction to any of the stumbles that are most likely inevitable in ambitious transformational initiatives such as those that are now underway.

Specifically from a design perspective, the launch of the new course in Design and Communication Graphics is very welcome. The introduction of the new Leaving Certificate curriculum in Art is urgently required.

Further Education and Training

Courses that are taught in small groups ensure that there is a sufficient quantity of teaching resources to teach in ways that promote creativity and develop innovative capability. However, in many cases there are obstacles:

- In many areas, the need to teach courses in this way has not been clearly identified by teaching staff or the organisations for which they work;
- While FETAC has improved matters significantly by requiring that courses include generic skills modules, there is a need to go further by specifying that these should be linked tightly to the main subject matter of the course, and that teaching methods for at least some other modules on each course should be designed to promote creativity and innovative capability; and
- As with any change in teaching methods, there is a teaching skills issue. There will be a need to diffuse good practice to teaching staff through training and other methods.

Taught Higher Education

The extent to which taught courses in the Irish higher education system develop creativity and capability to innovate among students is very uneven, so there is considerable room for improvement. Examples of good practice visible within the system demonstrate that addressing this is not purely a matter of resourcing, although the availability of teaching resources is one of the constraints limiting progress in the area.

Aside from the force of persuasion and good example, there are two existing sources of leverage that could perhaps be used to promote good practice in developing creativity and capability to innovate among students, given a relative minor recalibration of their focus.

- Any future cycles of the Higher Education Authority's Strategic Innovation Fund could more explicitly ask for proposals that address this need; and
- Quality assurance processes in the higher education sector could place a higher system-wide priority on creativity, which is already recognised appropriately within the National Framework of Qualifications.

Key practices that should be promoted include:

- Widespread use of cross-disciplinary project work, bringing together students from complementary disciplines;
- More project work in general; and
- Increased use of problem-based learning and inquiry-based learning approaches.

There is a need for a degree of balance in how this is approached. Any attempt to force all participants on all courses into a single good practice model will cause problems. On the other hand, there is a general need to push academics and students who are comfortable in a single-discipline environment into broadening their horizons, even if this means some discomfort. It is up to higher education institutions, funding bodies and quality assurance agencies to find the right way to strike this balance.

Higher Education by Research

The initiatives taken by the higher education system to add professional development courses and modules to PhD research programmes are very positive from a creativity and innovation perspective. There is, however, a need to go further, to tackle a disconnect that exists between science, engineering and technology (SET) disciplines on the one hand, and business on the other. This is necessary in order to develop the mutual empathy and understanding between business graduates and research SET graduates that is required if Irish research is to become more successful at spinning out start-up businesses. One very promising measure that could be taken would be to develop a system of joint coursework projects for PhD researchers and postgraduate business students. Other possible developments include increased use of industry placements for PhD researchers, and greater use of part time PhD study by people in employment. As in taught programmes, there is a need for balance in how this is approached (between using a single practice model only on the one hand, and, on the other, the need to broaden horizons among academics and students).

Finally, there is a need to boost research activity in management practice and in art and design, in order to develop capabilities to underpin increased innovation in Irish industry.

Developing Workplace Skills in Creativity, Innovation & Design

The optimal mechanisms to be used in delivering training that generates creativity, design and innovation are likely to be:

- Continuing the delivery of most Enterprise Ireland client services, including training, as at present;
- A much greater use of networks, whether formally designated as learning networks in the case of Skillnets training networks, or as innovation networks in the case of Enterprise Ireland networks;
- Responses by higher education institutions to perceived demand for part time education in areas related to creativity, design and innovation;
- A web-based open access initiative in creativity, design and innovation; and
- Creative, design and innovation skills have been recognised by the Management Development Council as integral to the successful management of companies. There is a need, therefore, to ensure that management development programmes incorporate modules into their offerings that enhance the CDI capabilities of Irish managers.

Chapter 4: Recommendations

Introduction

The recommendations that follow complement the Expert Group's existing findings and recommendations on skills and learning needs, which are relevant to building an economy based on creativity and innovation. They focus on those specific actions which the Expert Group believes are realistically achievable in current circumstances, and will contribute most to strengthening our creative and innovative capabilities. Each recommendation has a serious of associated actions to be undertaken by key actors and stakeholders in order to facilitate implementation.

The EGFSN is keenly aware of the resource constraints on implementing bodies in making the recommendations below. The implementing bodies are asked to action cost neutral recommendations as soon as possible; recommendations with resource implications as soon as resources are available; and to use opportunities in the redesign of programmes to implement the spirit of the recommendations.

Recommendation 1: The main responsibility for levelling up performance at third and fourth levels lies with colleges themselves. All Irish higher education institutions should set objectives in developing creativity and capability to innovate among their students as a part of their strategic plans and should regularly review progress against those objectives.

Other bodies can contribute to this, and indeed can provide an impetus to drive this change throughout the higher education sector.

- The Higher Education Authority should explicitly specify student creativity and capability to engage in innovation as an objective to be pursued under future Strategic Innovation Fund cycles. It can be used to drive, inter alia: greater use of team-based project work; inter-disciplinary project work with students from complementary disciplines; problem-based learning and inquiry-based learning; and flexibility for students to take some courses outside the main discipline they are studying.
- HETAC should review its policies on course descriptors and learning outcomes to ensure that the specifications for all courses thoroughly reflect the Framework requirement for competence in creativity. It should ensure that all reviews of courses and institutions give adequate weight to this requirement, and where possible are carried out by people capable of giving constructive criticism in the area.
- The Irish Universities Quality Board should look at issuing a Good Practice Guide in the area, similar to guides it has previously published on other topics. It should give the topic adequate weight in external quality reviews of institutions, and should ensure that it is well reflected in internal quality reviews.
- The Department of Education and Science should take account of the resourcing requirements of teaching approaches that promote creativity and innovative capability among students when reviewing funding and resourcing of higher education institutions. It should particularly support small group teaching where this demonstrably produces positive outcomes in creativity and innovative capability, and should seek to protect it when making decisions on funding of higher education institutions.

Implementing bodies: Department of Education and Science, HEA, HETAC, IUQB

Recommendation 2: Higher Education Institutions should make a major effort to break down the disconnect between SET and business disciplines.

They should start by piloting a system of joint coursework projects for PhD researchers and postgraduate business students. Institutions and funding bodies should also look at establishing industry placements for PhD researchers, and greater use of part time PhD study by people in employment. Strategic Innovation Fund, Programme for Research in Third Level Institutions and any

future Graduate Research Education Programme funding should be focused on initiatives in these areas.

Implementing bodies: HEA, higher education institutions

Recommendation 3: The Expert Group supports the thrust of the work of the National Council for Curriculum and Assessment in reforming second level education. Subject to the developments described in chapter 3 working successfully, they should be rolled out widely across the full range of subjects.

More specifically:

- Subject to successful evaluation of its early implementations, it is important that Project Maths should be rolled out nationally at a reasonably fast pace.
- The Department of Education and Science should devote adequate resources to the continuing training of teachers, to underpin the effective implementation of curriculum reform.
- The recommendations of the Task Force on the Physical Sciences, which address many of the key issues in creativity and innovation specific to the delivery of Chemistry and Physics curricula, should be implemented.
- The Department of Education and Science should approve the launch of the new curriculum in Art urgently.

Implementing bodies: Department of Education and Science, secondary schools.

Recommendation 4: To assist Irish businesses in assessing their skills in creativity, design and innovation using the frameworks presented in this report, and material from other sources, and to help them to respond to opportunities and deficiencies that they identify, an audit tool for this purpose should be developed.

This can then be made available to firms through multiple channels by relevant bodies and agencies. In the first instance, the development of the audit tool should be put out to tender by the Department of Enterprise, Trade and Employment.

Implementing bodies: Department of Enterprise, Trade and Employment, development and training agencies.

Recommendation 5: Skillnets and its stakeholders should place an increasing emphasis on funding networks that target skills in creativity, design and innovation.

- To encourage applications, Skillnets should consider establishing a fifth pillar to its strategic framework, focused on skills in this area, and should publish guidance and case studies to inform prospective networks. Skillnets should investigate the potential for virtual networks in creativity, design and innovation, based largely online.
- Enterprise Ireland should continue towards launching its Innovation Networks Programme, and should expand it if successful.

Implementing bodies: Skillnets and its stakeholders, Enterprise Ireland.

Recommendation 6: While continuing to develop and promote the use of standard modules in personal development across different subject areas, FETAC should encourage providers of further education and training to adapt the content to the subject matter of each course.

FETAC should look at introducing a requirement that courses contribute to developing creativity and innovative capability, particularly at Level 6 where it is explicitly a part of the National Framework of Qualifications, but also at other levels. It should integrate this into evaluation processes. This would impact on continuing education and training, as well as on initial education and training.
Implementing bodies: FETAC, FETAC course providers.

Recommendation 7: Organisations such as Enterprise Ireland, industry representative bodies and relevant higher education institutions should consider introducing a placement programme for Product Design graduates, broadly similar to the existing Export Orientation Programme.

As design is a market-facing discipline, it is likely that graduates participating would engage in some overseas travel, but the programme would not include an extended overseas placement similar to that in the EOP. The programme would ideally lead to an academic award, as the EOP currently does.
Implementing bodies: Enterprise Ireland, IBEC, higher education institutions.

Recommendation 8: Agencies including Enterprise Ireland and the Higher Education Authority, as well as higher education institutions, should support the development of a strong design skills development infrastructure, building organically on the existing infrastructure.

Key areas where skills-related developments are required from this infrastructure are in:

- Connecting undergraduate design education, particularly in industrial and product design, to industry through work placements;
- Developing postgraduate design education, at both taught masters and research degree level, with more students, tighter connections with industry and with other disciplines, and ideally a national cross-institutional Graduate School Programme in Design;
- Continuing education programmes, targeted on designers, on engineers and technologists, on marketers, and on managers requiring design thinking skills; and
- Extending an in-company service similar to that provided by the Centre for Design Innovation6 across the country.

Implementing bodies: Enterprise Ireland, HEA, higher education institutions.

6 The *Centre for Design Innovation* runs interactive workshops to help companies understand how to apply a design-led approach to innovation. Following each workshop, participants apply the new skills to their own organisations with the help of a Design Associate. Design Associates have cross-disciplinary experience within multiple business sectors and design disciplines. This facilitation and mentoring is key to integrating new skills and participants can request strategic expertise when needed. Companies receive five days of face-to-face time over the course of the programme and the continuous support of the Centre.

Chapter 1 Context

1.1 Introduction

This report addresses Ireland's need for skills in creativity, design and innovation. While skills relating to specific occupations and industries are often important for innovation, this report looks at cross-cutting skills that apply across broad swathes of occupations and across many industries. The scope of this study is limited to the requirements of the enterprise sector but the Expert Group is fully conscious that there are many ways in which the application of creativity, design and innovation are equally essential if the public sector is to be responsive to current service delivery needs. This study makes reference to the significance of a user-centred approach throughout, and the Expert Group notes that the OECD review of the Irish public sector has similarly pointed to the need for a 'citizen-centred' approach to service delivery. The implementation of the OECD review recommendations may provide a timely opportunity to take into account some of the relevant findings of this study.

The report complements existing work by the Expert Group on the skills needs of specific industries and specific occupations. It builds on existing work by the Expert Group on generic skills, upskilling and lifelong learning, all of which contribute to creativity and capability to be innovative.

In its treatment of creativity and design, the report focuses particularly on their role as drivers of innovation.

This chapter defines creativity, design and innovation, and describes how skills in these areas are key drivers of productivity growth. It demonstrates the connection between innovation and productivity, and reviews Ireland's performance on each. It addresses the economic impact of the "Creative Economy" – industries driven by specifically creative skills. It goes on to describe the economic role of design.

The chapter reviews the international competitive context, and demonstrates the importance of innovation in this context. Finally, it summarises Ireland's strategy for innovation, and puts this report in the context of that strategy.

1.2 Defining Creativity, Design and Innovation

This report is concerned with creativity, design and innovation in a business context, and so it uses definitions that are relevant to the business context.

- **Creativity** is imagination applied to the purpose of creating economic value. Most creativity is about finding ways to combine existing ideas to do something new.
- **Design** is the process of moving from an initial creative idea to developing a new or changed product, service or process that can be brought to market or implemented internally within a business.
- An **innovation** is change that creates economic value. This is generally through: creating a new or improved product or service; improving the way a business operates internally; or changing the

way the business relates to the business system of which it forms a part to bring greater value from its customers.

1.3 Skills in Creativity, Design and Innovation as Drivers of Productivity

Skills in creativity, design and innovation are key drivers of productivity improvement. Most productivity improvement comes out of new or improved products, services and business processes, which allow businesses to create more value out of the efforts of each worker.

Some of this productivity improvement flows from improvements in public infrastructure. Some flows from shifts in industry mix in favour of industries that add more value, usually enabled by increasing levels of qualification in the workforce, or from specialised skills in particular areas.

But a large share of productivity improvement arises, not so much from the assemblage of infrastructure and qualifications, so much as the capability to apply imagination to creating new value out of the knowledge, skills and resources to which businesses have access. It is skills in this messy, hard-to-pin-down area that this report seeks to address.

Just because the topic has not been an explicit focus of policy in Ireland does not mean that skills in the area are weak. By many measures, Ireland rates quite well on innovation and on productivity improvement, and this could not have come about without genuine strengths in creativity and innovative capability among the workforce. Even so, the report identifies major opportunities for improvement that have the potential to drive a positive shift in the rate at which Irish productivity improves.

"Skills in creativity design and innovation are key drivers of productivity improvement."

1.4 Connection between Innovation and Productivity

The connection between innovative capability and productivity is well established. It is illustrated quantitatively in Figure 1.1, which plots innovative capability against productivity growth for 29 countries, using the Global Summary Innovation Index (prepared by Pro-Inno for the European Commission) as the measure of innovative capability.

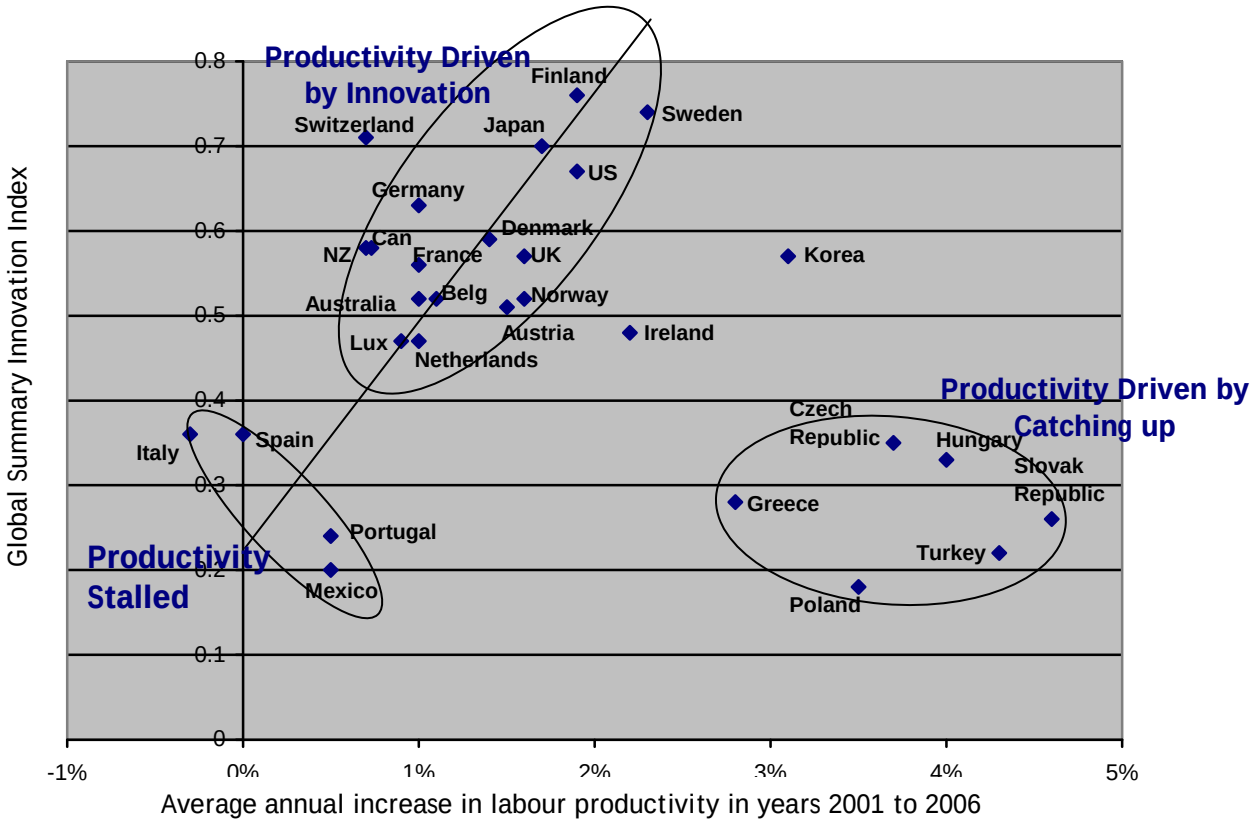
Countries fall into three groups:

- A group with low innovative capability and low productivity growth, for which productivity growth has largely stalled, made up of a number of southern European countries plus Mexico;
- A group of countries with higher innovative capability and higher productivity growth, for which there is an approximately linear relationship between innovative capability and productivity growth, ranging from countries such as Luxembourg and The Netherlands with medium innovative capability and productivity growth around 1 percent per annum, to countries such as Finland and Sweden with high innovative capability and around 2 percent productivity growth per annum; and

- A group of countries that have historically lagged behind leading economies, and for which much of the growth in productivity can be attributed to catching up with more developed economies.

Ireland and Korea are positioned between the two latter groups, as countries which have historically lagged behind leading economies in development, but have largely caught up, and are becoming reliant on innovation to drive productivity growth.

Figure 1.1 Relationship between Innovative Capability and Productivity



Sources: Labour productivity based on data from OECD Economic Outlook. Global Summary Innovation Index from Pro-Inno Europe, a composite index based on 12 indicators, organised under 5 headings: Innovation Drivers; Knowledge Creation; Diffusion; Applications; and Intellectual property.

Finland and Sweden are rated highly in the Global Summary Innovation Index mainly through their heavy investment in research, their highly qualified labour force and their success in obtaining patents. However, as the range of indicators included in the Index is narrow, it is reasonable to think that their success in driving labour productivity arises from a broader range of factors of which research, design, skills and intellectual property form an inseparable part. These include strong industry cluster infrastructure, effective integration between industry and research activities, and strong commercialisation capabilities. Of the two, Sweden is particularly well known for design, and is home to many strong design-focused businesses, including IKEA, Volvo and H&M.

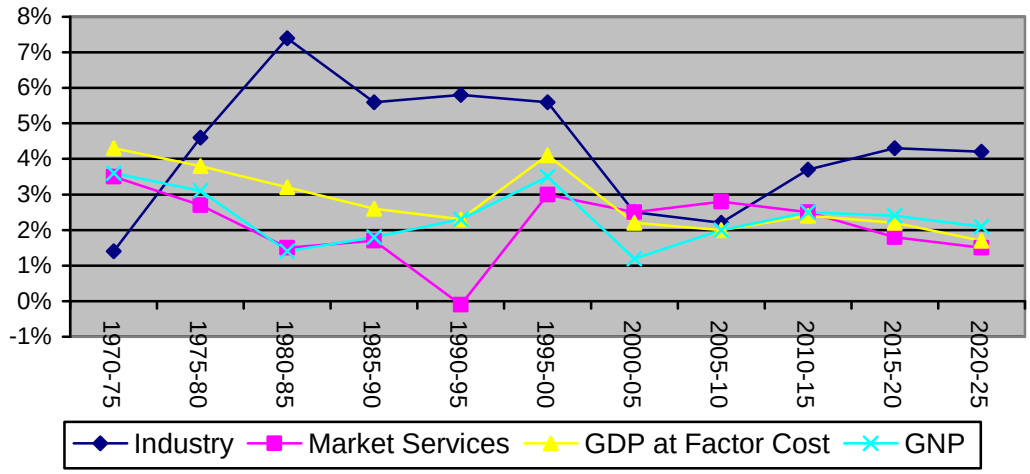
Innovative capability is certainly not the only driver of productivity growth. Other factors, such as infrastructure, competition, labour market flexibility and access to capital also play a role. However,

it would appear from Figure 1.1 that, for developed countries not recovering from a historical deficit in economic development, a highly innovative economy may experience productivity growth of 1 percent to 2 percent per annum above that experienced by economies that are significantly less innovative. Compounded over a period, advantages of this magnitude turn into major gains in competitiveness, and significantly greater economic well-being.

1.5 Trends in Irish Productivity

ESRI's Medium Term Review projects productivity growth of around 2 percent over the five year period to 2010, rising to 2.5 percent over the following five years, driven partly by a decline in low productivity construction employment. Projected productivity growth is lower than past averages largely because of a strong ongoing shift in the sectoral mix of employment towards market services, where productivity growth is generally lower than in manufacturing industry by several percentage points. The projections factor in heavy ongoing investment in human capital.

Figure 1.2 Irish Labour Productivity Growth per Annum – Historical and Projected



Source: ESRI Medium Term Review, 2008

According to the Review "if policies could be found to bring about a higher rate of productivity growth than in the *Benchmark* scenario this could have a significant beneficial impact on the living standards of all of the population". As innovative capability is one of the main drivers of productivity growth, it is therefore also a key driver of Irish living standards.

1.6 Business Impact of Innovation and Design

Innovation - change that creates economic value – is important to every business, and is the main driver of value creation for many businesses. It may be completely new, new to the industry, or new to individual business. Here are some examples of innovation and design, based on real businesses operating in Ireland.

- An Irish hairdressing salon introduced a card index to record details of colouring work done for each client, to ensure that it could be repeated reliably on each visit. The system improved consistency, and increased repeat business, and reduced the problems with continuity that occurred when a colourist left.
- A group of convenience stores in Ireland introduced a noodle dish offering at the hot food counters of some of its branches, inspired by observations on a study visit to Japan.
- Ireland has developed a strong and growing automation industry, which specialises in helping Irish and international process industries (particularly pharmaceuticals and food) to innovate by improving their production processes, increasing efficiency, improving quality, and ensuring regulatory compliance.
- A medical device company replaced visual inspection of products by human quality controllers with an automated machine vision inspection system. The number of products found to fail to meet specification post-inspection fell significantly. The quality control staff was retrained in quality assurance techniques, which they used to further improve quality and reduce waste, and to identify ways to make products easier to manufacture.
- In 1993, UCD formed a joint venture with a UK firm to develop diagnostic tests and vaccines for animal diseases. Research relating to BSE was carried out at UCD, leading to the development of Transmissible Spongiform Encephalopathy diagnostic technology. This was licensed to Enfer Scientific Ltd., which subsequently developed a rapid test for BSE using the technology. As a result, Enfer is now one of the major international vendors of BSE testing technology, and UCD earns significant royalty income.[7]
- Almost every software company's products are innovative, different in a range of respects from those of competitors. Business applications software products typically encapsulate business process innovations, and are licensed or bought by customers as a shortcut to business process innovation. For example, an Irish software company developed software to enable banks to support business customers in shifting low value purchases to credit cards. This gave the banks' customers greater control over their purchases, while reducing their administrative costs. It increased bank revenues, and gave customers another reason to stay with their bank. While the company had competitors globally, it developed a strong position in Europe by specialising in serving the specific needs of European customers.
- Java Republic, the Irish coffee supplier, uses packaging design as a key element of the branding that has allowed it to build a successful business.
- Ireland has a history of success in innovating in mobile telephony services, with Aldiscon having played a key role in the emergence of text messaging, and with a significant cluster of companies now in place, many of them important international players. One of these is Changing Worlds, a spin-out from research at UCD, which has technology that allows more than 50 mobile telephony operators globally to offer search services to their customers.
- Moffat Engineering, of Co. Monaghan, was founded to produce the Moffat Mounty, the first forklift truck designed to be carried on the back of a goods vehicle to load and unload the cargo. When the company was taken over, its Director of Engineering developed the world's first engine-powered, all wheel drive, multi-directional forklift, and established Combilift to manufacture it. This innovative

7 See, for example: http://www.ucd.ie/nova/news/newsarchive/2004/novanewstitle,14613,en.html

forklift solves the problem of needing multiple forklifts to handle long loads, and the company, established in 1998, now leads the world in this area[8].

1.7 Irish Performance on Innovation

Ireland ranks high in terms of the proportion of companies engaged in innovation. In the most recent period for which comparable statistics are available, Ireland ranked 7th in the EU for the share of its companies engaged in innovation[9].

The Community Innovation Survey for 2004-2006 found 47.2 percent of Irish enterprises with ten or more employees engaging in innovation activities, as set out in Figure 1.3. Bigger companies are more likely to innovate than smaller ones. Manufacturing companies are more likely to innovate than those in services, which is consistent with the higher rates of productivity growth seen in manufacturing.

Figure 1.3 Irish Innovation Rates by Sector and Size of Enterprise, 2004-2006

	Small (10-49)	Medium (50-249)	Large (250+)	All Enterprises
Industry	51.4%	67.3%	84.2%	56.7%
Services	38.1%	57.5%	63.1%	41.3%
Total Industry and Services	**42.7%**	**62.5%**	**74.9%**	**47.2%**

Source: CSO/Forfás – Community Innovation Survey 2004-2006

The Community Innovation Survey addresses three main types of innovation – product innovation and organisational innovation. Product innovation is a little more prevalent than process innovation, as can be seen in Figure 1.4. Organisational innovation is significantly more common than each of the other types of innovation in SMEs.

Figure 1.4 Irish Innovation Rates by Sector and Size of Enterprise, 2004-2006

	Small (10-49)	Medium (50-249)	Large (250+)	All Enterprises
Product Innovation	29.0%	47.7%	62.4%	33.3%
Process Innovation	26.7%	40.7%	60.0%	30.3%
Ongoing or Abandoned Innovation	2.3%	2.8%	0.0%	2.3%
Any of Above	**42.7%**	**62.5%**	**74.9%**	**47.2%**
Organisational Innovation	38.9%	50.0%	61.0%	41.6%

Source: CSO/Forfás – Community Innovation Survey 2004-2006

8 See: http://www.entemp.ie/press/2006/20060622b.htm

9 CSO, Community Innovation Survey 200-2006

However, while the prevalence of innovation in Ireland is relatively high, broader measures of Irish innovation capability indicate that the country is actually fairly average, rather than a leader, among developed countries. This was seen earlier in Figure 1.1.

It suggests, overall, that we are not very much different in innovative capability to countries such as the UK, France and the Netherlands, but behind innovative countries such as Denmark, Germany, Japan, Sweden, Finland and Switzerland. Many of the more recent accession states to the European Union are behind but catching up on innovative capability, as are Greece and Portugal.

However, even within that medium-performing group, Ireland is not altogether typical, as may be seen in Figure 1.5.

Some of the measures of innovation on which Ireland performs well and poorly relate to public and infrastructural inputs to innovation. Ireland ranks first on its output of new science and engineering graduates (although the data is from 2004, and numbers have decreased since), and on the share of enterprises in receipt of public funding for innovation. It also ranks well on the educational attainment of the youth population. It ranks poorly on broadband penetration rate, and on public R&D expenditures, (although again the data are from 2004, and Irish public expenditure on R&D has increased since).

Some of the measures on which Ireland performs well relate to firm capability and innovation outputs. Ireland ranks first in terms of the share of SMEs that innovate in house, and in terms of the share of SMEs that practice organisational innovation. It also ranks well on exports of high technology products, reflecting the strength of the country's ICT, pharmaceutical and medical devices industries, although this is more strongly a function of overseas-owned operations being located in Ireland, than a reflection of export sales resulting from Irish-based innovation.

Notably, Ireland performs relatively poorly on sales of new-to-firm products, while performing around average (rank 16) on new-to-market products.

Figure 1.5 Measures of Innovation on Which Ireland has a High or Low Rank on a List of 34* Countries EEA plus US, Japan, Turkey

	Measures of Innovation by Which Ireland has a High Ranking		Measures of Innovation by Which Ireland has a Low Ranking	
		Rank		**Rank**
Public and Infrastructural Inputs to Innovation	New Science & Engineering graduates	1	Broadband penetration rate	25
	Enterprises receiving public funding for innovation	1	Public R&D expenditures	24
	Youth education attainment level	9		
Firm capability and innovation outputs	SMEs innovating in-house	2	ICT expenditures	28
	Exports of high technology products	3	Sales of new-to-firm products	25
	Community trademarks per million population	6		
	SMEs using organisational innovation	7		

Not all countries are scored on every measure.

Source: Based on assessments of Current Performance from European Innovation Scorecard 2006, Pro-Inno Europe

Taking account of the fall-off in graduate numbers in key SET disciplines and the increase in public R&D expenditures over the intervening period, Ireland stands out on the positive side for:

- A high incidence of innovation generally;
- A high incidence of organisational innovation;
- Heavy public investment in assisting firms to innovate;
- Substantial, technology exporting industries, which include significant Irish-owned operations, and significant innovative activity, but in which exports are primarily based on the transfer of innovations to Ireland, much more than on Irish-based innovation; and
- Fairly good levels of youth education.

On the negative side, Ireland stands out for:

- Low adoption of product innovations invented by others, while being fairly typical on adoption of product innovations invented in-house; and
- Low business investment in ICT.

1.8 Economic Impact of the Creative Economy

Complementing the general economic impact of creativity, through driving innovation and hence productivity growth, creative industries offer particular potential for economic benefit. The UN Creative Economy Report 2008 has addressed this topic, based on the following thinking.

" …the interface among creativity, culture, economics and technology, as expressed in the ability to create and circulate intellectual capital, has the potential to generate income, jobs and export earnings while at the same time promoting social inclusion, cultural diversity and human development. This is what the emerging creative economy has already begun to do as a leading component of economic growth, employment, trade, innovation and social cohesion in most advanced economies."

The "Report provides empirical evidence that the creative industries are among the most dynamic emerging sectors in world trade. Over the period 2000-2005, trade in creative goods and services increased at an unprecedented average annual rate of 8.7 per cent. World exports of creative products were valued at $424.4 billion in 2005 as compared to $227.5 billion in 1996, according to preliminary UNCTAD figures. Creative services in particular enjoyed rapid export growth – 8.8 per cent annually between 1996 and 2005."

The report defines creative industries as including the following:

- Heritage
  - Traditional cultural expressions: arts and crafts, festivals and celebrations;
  - Cultural sites: archaeological sites, museums, libraries, exhibitions, etc.
- Arts
  - Visual arts: painting, sculpture, photography and antiques;
  - Performing arts: live music, theatre, dance, opera, circus, puppetry, etc.
- Media
  - Publishing and printed media: books, press and other publications;
  - Audiovisuals: film, television, radio and other broadcasting.
- Functional creations
  - Design: interior, graphic, fashion, jewellery, toys;
  - New media: software, video games, and digitalized creative content;
  - Creative services: architectural, advertising, cultural and recreational, creative research and development (R&D), digital and other related creative services.

Software is an industry which some creative industry definitions include, some others do not, and some include in part. In the Irish context, the size and importance of this industry means that it is necessary for any statement regarding the economic impact of the creative economy to be clear as to whether software is included, and, if so, whether it is included in whole or part.

The report quantifies the contribution of creative industries to many countries, Ireland included. Figure 1.6 shows that cultural and creative sectors contribute 1.7 percent of GDP in Ireland. This is relatively low by the standards of developed European economies. It suggests that there may be significant scope to expand these industries.

Figure 1.6 Contribution of the European Cultural and Creative Sector to the European National Economies, According to the UN

	Turnover, 2003 (€ million)	Value added as % of national GDP
Austria	14,603	1.8
Belgium	22,174	2.6
Cyprus	318	0.8
Czech Republic	5,577	2.3
Denmark	10,111	3.1
Estonia	612	2.4
Finland	10,677	3.1
France	79,424	3.4
Germany	126,060	2.5
Greece	6,875	1.0
Hungary	4,066	1.2
Ireland	**6,922**	**1.7**
Italy	84,359	2.3
Latvia	508	1.8
Lithuania	759	1.7
Luxembourg	673	0.6
Malta	23	0.2
Netherlands	33,372	2.7
Poland	6,235	1.2
Portugal	6,358	1.4
Slovakia	2,498	2.0
Slovenia	1,771	2.2
Spain	61,333	2.3
Sweden	18,155	2.4
United Kingdom	132,682	3.0
Bulgaria	884	1.2
Romania	2,205	1.4
Norway	14,841	3.2
Iceland	212	0.7
Total European Union (25 countries)	636,146	
Total 30 countries*	654,288	

The statistical classification behind the above excludes most software, but includes new media.

Source: UN Creative Economy Report 2008 (from Eurostat and AMADEUS data, elaborated by Media Group)

UN statistics show Ireland to be a leading exporter of recorded music ($801m in 2005, 6th largest in world) and new media ($698m in 2005, 2nd largest in world).

Irish exports of creative goods in 2005 totalled $2,275m (€1,860m), compared with imports of $2,399m (€1,961m).

Irish exports of creative services[10] totalled $871m (€712m), with just over half made up of R&D services in 2005, compared with imports of $4,550m (€3,720m) almost entirely made up of R&D services. This primarily reflects fees for intellectual property.

Irish exports of creative goods and creative services totalled $2,399m and $871m respectively in 2005.

UN Creative Economy Report 2008

Figure 1.7 presents an outline of employment in creative occupations in Ireland, taking the UN list of creative industries as a guide in selecting occupations from the Census of Population.

Figure 1.7 Irish Employment in Creative Occupations, 2006

Occupational Categories	2006 Employment	Share of Employment
Authors, writers and journalists	6,096	0.29%
Artists, commercial/industrial artists, graphic and clothing designers	9,277	0.45%
Actors, musicians, entertainers, stage managers, producers and directors	6,165	0.30%
Photographers, camera, sound and video equipment operators	2,640	0.13%
Cabinet makers	4,055	0.19%
Other woodworking trades n.e.s.	1,051	0.05%
Glass product and ceramics makers, finishers and other operatives	2,825	0.14%
Subtotal	32,109	1.54%
Software engineers	11,180	0.54%
Computer analyst programmers	18,619	0.90%
Subtotal	29,799	1.43%
Overall Total	**61,908**	**2.98%**

Source: Census 2006

Whether or not the software industry is included, Ireland's creative economy makes a significant contribution, which has potential to grow substantially.

10 This total does not include creative goods, including recorded music and new media.

1.9 Role of Design

Internationally, there is an increasing policy focus on leveraging design as a driver of innovation. This is, for example, reflected in the UK's *Cox Review of Creativity in Business* (2005) and the UK Government's subsequent report, *Creative Britain – New Talents for the New Economy* (2008). It is also reflected in an increasing focus on design in countries as diverse as Denmark (generally recognised as a design leader), Australia, Taiwan and China.

Internationally there is an increasing policy focus on leveraging design as a driver of innovation.

There is an increasing international interest in design-led innovation as a philosophy and methodology for innovating, in competition with innovation led by technology or science. Where technology-led innovation takes a new technological insight or capability as the starting point for developing a new product or service, design-led innovation starts from analysing and understanding the user experience, and typically uses existing technologies to create products and services that give users a great experience.

While some proponents of design-led innovation argue that it is superior to technology-led and science-led innovation, most governments are choosing to continue to invest in research, and are supplementing this by also investing in infrastructure (such as centres of design expertise) to improve industry product and service design capability. It is not a difficult choice to make – where most developed countries spend hundreds of millions, or billons of euro per annum on research focused on science and technology, even a major national design initiative is more likely to cost tens of millions, and it is possible for design to have a major impact even at a more modest cost.

Ireland has made some limited moves in this direction, with support for design now being a frequent feature of Enterprise Ireland company development supports, and with the recent establishment of the Centre for Design Innovation, based at Sligo Institute of Technology. While it is not the purpose of this report to make recommendations beyond the skills arena, these appear to be positive first steps towards developing an effective design strategy for Ireland.

While governments, and some businesses, may think in terms of innovation led by science and technology versus design-led innovation, most businesses seem to take a more mixed approach, drawing creative ideas for product and service innovation from a range of sources. Some may come from research. Some may come from technology bought or licensed. Some may come from users, or from businesses investigating the user experience. Some may come from market trends.

Even so, the extent to which businesses focus on the user experience, and the extent to which they draw on design skills, when innovating, is increasing. There are good reasons for this.

- There is increasing interest among consumers in products and services that appeal to them emotionally, and complement or reinforce their self image. Products and services that cater to this interest account for an increasing share of consumer spending throughout the developed

world. They often attract higher prices and margins[11] than products and services endeavouring to compete on price and quality, on which it is increasingly difficult to differentiate from international competitors.

- As populations become wealthier, peoples' discretion over how they spend their money increases, giving them freedom to choose to pay more for something that really appeals to them, rather than having to settle for the cheapest product or service that meets their basic requirements for quality. In terms of Maslow's well-known hierarchy of needs, people in developed countries increasingly focus on the top level self-actualisation need in their purchasing decisions.
- Good design, based on a thorough understanding of the user experience, allows businesses to produce products and services that appeal to this deeper emotional need.
- Outside the field of consumer products, there is vast scope for businesses to innovate through working with users, and indeed sometimes through adopting innovations already pioneered by users. This is one of the major themes of the literature on innovation, such as for example in the work of Eric Von Hippel[12] on the Lead User Method for product development.
- Detailed analysis of this sort is already central to innovation in some industries, notably medical devices where most innovations come from working with clinicians, and software applications, where successful products and services typically come out of a deep understanding of how they will be used. There is scope for it to be used much more widely in other industries.
- Studying the experiences of people working on processes is a major source of ideas for process innovation within a business, whether through detailed study of people working on a process within the business itself, or undertaking benchmarking at other businesses undertaking similar processes.

Whatever its relationship with other enablers of innovation, the big picture is that design allows jobs to be retained in developed countries, offsetting the effect of high costs. In some cases, it raises the value added by a business sufficiently to allow some or all of manufacturing operations to be retained in a developed country. In others, it at least boosts the knowledge content of the business, increasing the number of high value adding jobs that are best kept in the developed country, close to customers.

'Good design is now the driving force behind how our products are produced and packaged, branded and marketed. Tangible benefits of being a member of the Design Shannon Skillnet to date include a 100 percent increase in cash flow and growth of 150 percent in our exports.'

Dermot Scanlon, MD of Serosep Ltd.

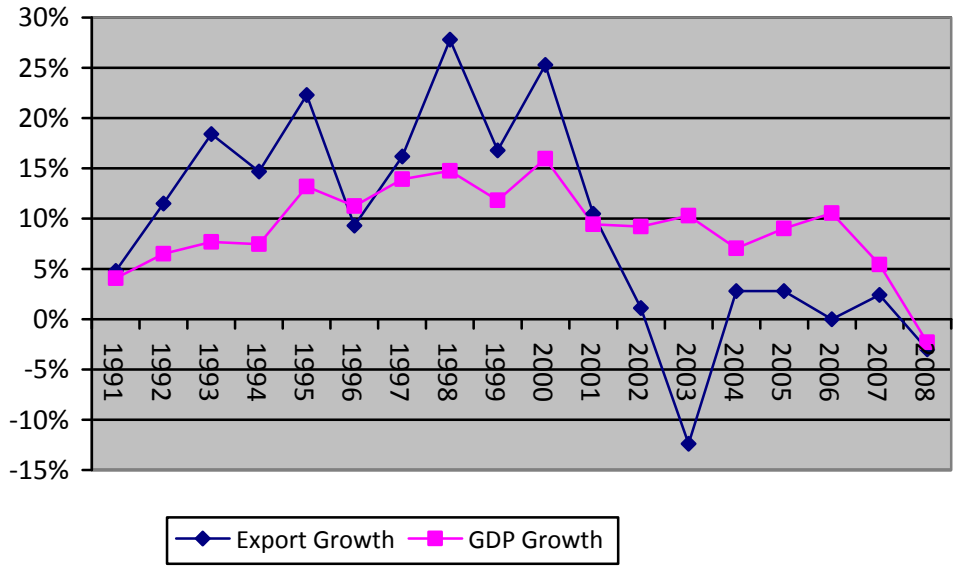
11 Sometimes the appeal is to an emotional desire for thrift, and in these cases the reward is business success despite low prices and perhaps low margins, through volume or customer tolerance of the service consequences of low costs.

12 Professor of Innovation and Entrepreneurship at the Sloan School at MIT. See "The Sources of Innovation" (1988) and "Democratizing Innovation" (2005), available for free download from the author's web page at: http://web.mit.edu/evhippel/www/.

1.10 International Competitive Context

Ireland is at a cross-roads in its economic development. After a decade of exceptionally strong export driven economic growth up to 2001, exports stalled in 2002, and have grown only slowly since then, as may be seen in Figure 1.8. Under difficult economic conditions internationally, Irish exports fell by 3 percent in 2008. Strong economic growth continued up to 2007, however, driven particularly by construction sector and non-traded service sector growth.

Figure 1.8 Irish GDP Growth and Export Growth



Source: Based on CSO data

However, activity in the construction sector is now contracting rapidly. The most current labour force data show falling employment in domestically traded service industries generally, and more retail sales data now show retail sales falling year-on-year, after a period expanding by around 6 percent to 8 percent per annum.

In its Q2 2009 Economic Bulletin, the Central Bank has projected that GDP will fall by 7 percent in 2009 and by another 3 percent in 2010, before recovery starts.

The ESRI's last Medium Term Review (May 2008) projected growth potential of 3.75 percent per annum over the next decade, based on labour supply projections and trends in productivity. While this was much lower than growth rates experienced over the last decade and a half, it was significantly higher than projections for the European Union as a whole. The dependence of such positive outcomes on productivity growth made productivity, and associated issues of competitiveness, one of the key economic policy challenges facing the country.

In a more recent paper examining economic recovery scenarios for the Irish economy, the ESRI has adjusted downward its potential growth rate over the ten years to 2020 to 3 percent annual growth[13]. The deterioration in economic prospects since then has only accentuated the need for innovation and productivity growth. This is recognised in the Government plan "Building Ireland's Smart Economy - A Framework for Sustainable Economic Renewal"[14], one of the key pillar's to Ireland's response to the current economic difficulties. One major action area within this is "Building the Ideas Economy – Creating The 'Innovation Island'".

However, turning the intention to innovate into international competitive advantage and renewed economic growth will be challenging, as Ireland is facing a competitive squeeze from overseas competitors.

- Through its rising cost of labour and services, and through the emergence of lower cost competitors in China, India, Central and Eastern Europe, and elsewhere, Ireland has moved from being a location with relatively low costs to being a high cost centre for many activities. The country is now a viable location mainly for high value-added activities where an operation located in Ireland can perform better than one located in a lower cost environment, whether through better skills and knowledge, better infrastructure, or locational advantages such as being physically or culturally closer to markets.
- At the same time, the boost to productivity improvement that Ireland has historically derived through catching up with more developed economies is close to disappearing, as the country catches up.
- While Ireland is investing heavily in boosting productivity, through investing in skills, research, infrastructure and company development, most other countries are behaving similarly. Countries that we now think of as low cost competitors, such as China, India and Brazil, are not aiming just to occupy the low and medium value added positions in the world economy that Ireland and other developed countries are vacating. They are aiming to develop much the same sort of high-added value knowledge economy that we are. They too are investing heavily in skills, research and modern infrastructure, and in many cases also in company development.

While Ireland is investing heavily in boosting productivity through investing in skills.
Research infrastructure and company development most other countries are behaving similarly.

In the past, Ireland's outstanding economic performance has come out of a very distinctive positioning relative to other countries – with a strong supply of skills, English language, low corporate taxation and low costs relative to other politically stable participants in the global economy. Now, we are jostling for space in a global economy in which all developed and actively developing participants are aiming for much the same broad positioning.

13 ESRI, Recovery Scenarios for Ireland, May 2009
14 Department of An Taoiseach, 2008

However, the increasing complexity of the global economy means that product-market niches are proliferating within the global economic ecosystem, and there is scope for Irish industries to differentiate through winning in niches different to those dominated by competing countries.

In effect, there are many races underway. As in the Olympics, there is room for many winners, and as a small country we can't hope to win everything. But we can thrive by winning golds, silvers and bronzes in the industry niches that suit us best.

In a world in which innovation is critically important, we can derive advantage from competing on our differences, whether these are cultural, or result from superior insight into particular markets, or from a particular expertise in applying technologies, or from specialist scientific, technological or business expertise. Ireland's unique economic, cultural and social history has given us a fund of differences that we can leverage into superiority in creativity and innovative capability in many product-market niches if we make the effort, and invest in the capabilities and skills we need.

However, as in the Olympics, success is not guaranteed. Countries that are less effective at innovating and driving productivity face a long term future of slow economic growth and incomes that will fall behind those in more successful countries. At a time of economic stress, it is important not to lose sight of this reality.

1.11 Ireland's Innovation Strategy

Much of Ireland's strategy for driving innovation has already been mapped out, through actions across a broad range of policy areas, summarised recently by the Department of Enterprise, Trade and Employment and Forfás in *Innovation in Ireland* (2008). The principle elements are:

- Knowledge creation – building a world-class research system;
- Knowledge transfer – bringing research to industry and the marketplace;
- Skills development – building a sufficient supply of high quality skills, and developing lifelong learning;
- Public procurement – leveraging public procurement policies to promote innovation;
- Networks, clusters and gateways – building collaboration between businesses directed at innovation through business networks, close linkages within industry clusters (including links with higher education and suppliers) and supporting innovation in regions outside Dublin and the Mid-East;
- Intellectual property protection and management - protecting intellectual property to maximise return on investment;
- Services and emerging sectors - increasing innovation in sectors that have not traditionally been the focus of enterprise policy;
- Entrepreneurship and business expansion – start-up funding, fostering entrepreneurship, and giving access to know-how and facilities;
- Partnership and workplace innovation – developing participative innovation in workplaces through initiatives including the Workplace Innovation Fund; and
- Competition and better regulation – competition fuels innovation, and regulation can constrain or encourage innovation.

The Expert Group on Future Skills Needs has regularly reported on skills needs in a range of areas of science, engineering and technology, and on the need for skills in a range of business areas. In the main, these are the key specific specialist skills required for innovation.

The Expert Group has also regularly focused on the need for lifelong learning, for example in *Tomorrow's Skills: Towards a National Skills Strategy*[15]. Again, this is required to promote innovation, both because:

- Higher, deeper and more up-to-date specialist skills and knowledge better prepare people better to be creative and innovative; and
- Higher levels of qualification often provide a vehicle for also developing other skills useful to creativity and innovation.

This report takes the need for both the skills in the specialist areas addressed by earlier reports, and lifelong learning, as established, and addresses:

- The complementary skills needed by people with specialist skills to enable them to be creative, and to perform effectively as innovators;
- The skills in design that are required, whether among professional designers, or among people from other specialisms;
- The contribution that other specialist skills in the arts, humanities and social sciences can make to creativity and innovation; and
- Further measures required to develop the skills required for innovation in the workplace.

The report also proposes to build on other existing elements of Ireland's innovation strategy.

- Skills in creativity, design and innovation play an important role in knowledge creation and knowledge transfer, and this is reflected in the report. Higher education research, supported through funding agencies including HEA, Science Foundation Ireland, IRCSET, IRCHSS and the Health Research Board, plays a key role in developing high level specialist skills. Indeed, one of its major functions is to train professional innovators. This report takes the need for the specialist skills developed through PhD and postdoctoral research as established, and focuses on the complementary skills required to make PhD graduates as effective at innovating as possible.
- Many of the benefits of industry networks and clustering are embodied in skills. Industry networks provide one of the most effective mechanisms available for developing skills in creativity, design and innovation in the workplace. Education and research play a key role in most industry clusters, and represent one of the main ways in which public policy can contribute to the innovative capability of clusters.
- There is a close relationship between entrepreneurship, and creativity and innovation. The report's recommendations are intended, in part, to boost entrepreneurial activity as a route to turning inventions into innovations.

15 Tomorrow's Skills: Towards a National Skills Strategy, EGFSN, March 2007

- Skills play a large part in workplace innovation. Participative innovation programmes, such as 6 Sigma, Lean Manufacturing and the initiatives supported under the Workplace Innovation Fund, rely heavily on generic skills in areas including teamworking, communication and problem solving, and on skills in working with others who have complementary expertise. The need to develop skills in these areas is a key focus of the report.

1.12 Conclusion

Creativity and design are key drivers of innovation, which is in turn a key driver of productivity growth. By the standards of developed countries, Ireland is no more than medium ranked on overall measures of innovative capability. While Irish businesses are more likely than those of most other countries to engage in innovation, the country's innovative capability is weak in some other respects. There is a critically important need to boost innovation, in order to underpin productivity growth, and skills in creativity, design and innovation have an important role to play in this. We cannot afford to lose sight of this during the current period of economic stress.

Creative industries make a significant contribution to the national economy, and have potential to make a much larger contribution. The findings of this report tie in with, and build upon, existing elements of Ireland's strategy for innovation, as described recently by the Department of Enterprise, Trade and Employment and Forfás in *Innovation in Ireland*.

Chapter 2 Skills in Creativity, Design and Innovation

2.1 Introduction

This chapter looks at what skills in creativity, in design and in innovation mean in practical terms.

It presents a framework describing six types of learning required for **creativity**, and reviews each of the six.

It discusses skills in **design**, considering three broad categories – those of engineers and applied scientists, those of designers and those of artists. It describes design thinking, and looks at the skills required by designers.

It also describes **innovation**, and how it is relevant in all parts of a business. It reviews the sources of innovation, which include technology and the user perspective that is embedded in design thinking, but also a number of other perspectives.

It highlights the importance of design, art and a range of humanities and social science disciplines for innovation.

Finally, it looks at how the role of innovation varies across occupations and industries, and the implications this variation has for innovation-related skills.

2.2 Skills in Creativity

It can be difficult to think of creativity, or "applied imagination", as a skill. Indeed, by at least one definition, its very unpredictability means that it is not a skill.

"A skill is the learned capacity or talent to carry out pre-determined results often with the minimum outlay of time, energy, or both."

However, in the arena of creativity, design and innovation, the meanings of terms shift depending on the writer, and it is better to simply aim for clarity and consistency of expression within a document than to insist on particular meanings for terms.

While the spark of creativity itself is difficult to pin down in skills terms, it is surrounded by identifiable and definable skills that are necessary for creativity. Moreover, while creativity itself cannot be taught as a simple procedure, it is possible for people to learn to do it better.

The vast majority of business creativity comes from finding new ways to combine existing ideas and knowledge, rather than in the form of fundamentally new ideas. For this reason, it far more

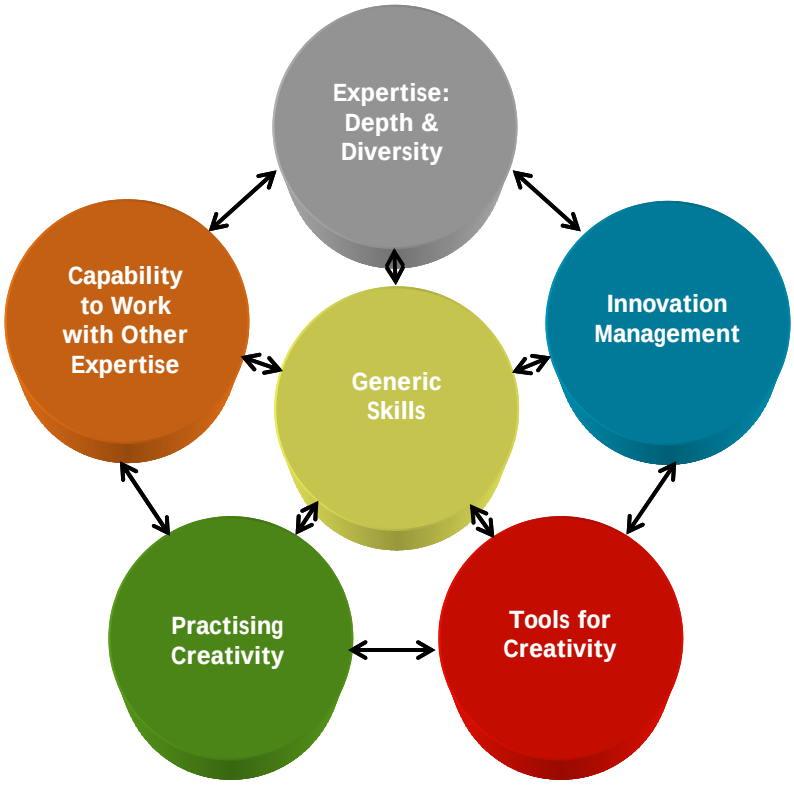
frequently comes out of interaction between people with different knowledge and perspectives than out of a lone creative genius.

Based on a review of the literature, and interviews undertaken for this study, there are six types of learning required in order to engender creativity in an organisation.

These are:

- Generic skills
- Expertise
- Capability to work with other sources of expertise
- Tools for creativity
- Practising creativity
- Innovation management

Figure 2.1 Six Types of Learning Required for Creativity



Source: Original framework based on research

Generic Skills

The first pre-requisite for creativity, which underpins the others, is generic skills. There are many frameworks to describe these, but their essence and breadth are captured well by the following four, which are little different in underlying content, but which usefully illuminate the topic by addressing it from slightly different angles.

Businesses and academics consulted are clear that a strong foundation of generic skills is required to enable people to be meaningfully creative in a business context. Skills in areas such as problem solving, information processing and critical thinking are fundamental to exercising creativity. Skills in areas including communication, teamworking and working with others are necessary because business creativity is usually the outcome of an interactive process.

1 In "Tomorrow's Skills – Towards a National Skills Strategy", the Expert Group highlighted the increasing importance of generic skills, and set out the following summary:

- Basic/fundamental skills — such as literacy, using numbers, using technology;
- People-related skills — such as communication, interpersonal, team-working, customer-service skills; and
- Conceptual/thinking skills — such as collecting and organising information, problem-solving, planning and organising, learning-to-learn skills, innovation and creative skills.

2 The following triplet of generic skills was mentioned repeatedly in interviews undertaken for the study, and seems well accepted as a summary of underlying generic skills required by businesses:

- Problem solving;
- Communication; and
- Team working.

Some of those consulted introduced variations on this theme, highlighting the transformative impact that information and communications technologies have had on communication and teamworking, particularly among schoolchildren, students and younger adults. Technologies such as wikis, Twitter and social networking sites are boosting interconnectedness, and providing new channels for communication and cooperation that may be almost invisible to over-30s. Teamworking involving people in locations far distant from each other, who may never actually meet, is growing in many large companies, and even across company boundaries. This is supported by layering new technologies for communication and cooperation on top of telephone and e-mail, including instant messaging, increasingly ubiquitous video conferencing and various tools for managing project documentation that do not depend on location.

3 The National Council for Curriculum and Assessment (NCCA) has developed a framework for Key Skills at Senior Cycle, with each skill area linked to a larger number of elements, each of which is in turn linked to a series of learning outcomes. The five key skills in the framework are:

- Information processing
- Creative and critical thinking
- Communicating
- Working with others; and
- Being personally effective.

4 The US Partnership for 21st Century Skills framework, designed for US schools, has four top level skills:

- Core Subjects (English, Maths, Science, Economics etc.) and 21st Century Themes (crosscutting themes are: global awareness, financial, economic, business and entrepreneurial literacy, civic literacy, health literacy);
- Learning and Innovation Skills (Creativity and Innovation Skills, Critical Thinking and Problem Solving Skills, Communication and Collaboration Skills);
- Information, Media and Technology Skills (Information Literacy, Media Literacy, ICT Literacy); and
- Life and Career Skills (Flexibility & Adaptability, Initiative & Self-Direction, Social & Cross-Cultural Skills, Productivity & Accountability, Leadership & Responsibility).

Expertise

The second pre-requisite for creativity is sufficient relevant expertise to be able to contribute to thinking clearly about a problem, and contribute to generating and evaluating ideas about solutions. This does not mean turning over a problem to a single specialist. In general, it means bringing diverse perspectives together, which will at least include:

- A knowledge of the domain in which the problem lies;
- A knowledge of technologies that may be used in addressing the problem, and
- A knowledge of the business aspects of the problem.

Often, the domain knowledge comes out of well established expertise, although it is well documented that experts are often slow to imagine radically different ways of doing things. Sometimes, it comes from expertise in a related area, which may have less depth, but have fewer preconceptions.

Sometimes, domain knowledge comes from studying user interaction, with the underlying skill being in observation and analysis, rather expertise relating to the domain itself.

Cultural diversity can contribute to the diversity of perspectives brought to an issue.

Some examples:

- Often, participative teams engaged in improvement processes in a manufacturing plant will observe and video the process they are trying to improve, and will document process, and identify opportunities for improvement based on their observations;
- Increasingly, design-led projects to develop new consumer products engage behavioural scientists in areas such as ethnology and anthropology to observe and analyse how consumers interact with existing products, and with prototypes of new products.

Capability to work with other sources of expertise

The third pre-requisite for business creativity is the capability to work with people who have other types of expertise. It is very unusual in a business context for a single person to be the most expert in the domain, the relevant technologies and the business aspects of a problem. Even where they are, the prospects for a creative solution are usually enhanced by interaction with others who have relevant expertise.

Much of the literature about educating people to be innovative talks about people with "**T**-shaped skills". The vertical leg of the **T** refers to having an in-depth knowledge of an area.

- For a postdoc researcher this could perhaps be deep knowledge of a narrow aspect of cell apoptosis[16].
- For a marketer, this could be marketing of software to a particular vertical market[17].
- For a check-out assistant at a retailer, this could be a practical understanding of the flow of customers and goods through a check-out.

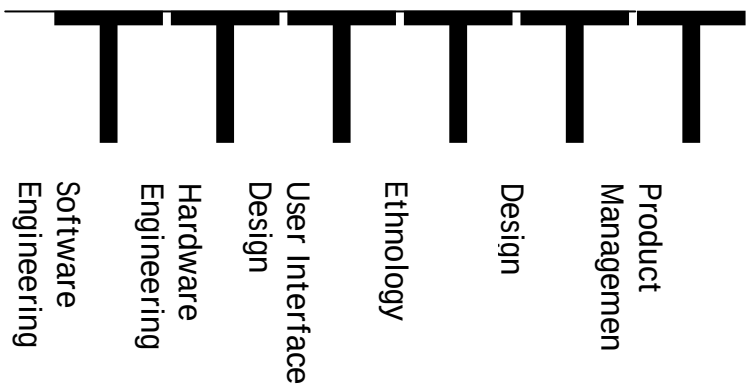
The horizontal bar of the **T** refers to having the capability to work with other sources of expertise.

For example:

- The idea for a new medical device often comes out of cooperation between clinicians with an idea for a new or improved treatment, engineers whose expertise is primarily technical, and business experts whose expertise is primarily in what can be turned into a viable business.
- The conceptual stage of effective web development typically involves cooperation between a web design specialist and one or more web technology specialists, and may involve others such as a web marketing specialist.

The horizontal bar of the **T** acts to join the different areas of expertise required for creativity together, as illustrated in Figure 2.2.

Figure 2.2 Illustration of the Horizontal Bar in T-Shaped Skills (Example is of Areas of Expertise that Might be Required in Imagining a New Consumer Electronics Product)



Source: Based on example quoted in an interview

16 An area of biological sciences relating to programmed cell death.

17 A vertical market is a market defined by an industry sector of customers, such as healthcare.

The main skills involved in working with other areas of expertise are:

- Strong in-depth expertise in at least one area important to the project, so that it is clear to other participants that the person is capable of making a useful contribution;
- Good generic skills in communication and teamworking;
- A basic understanding of the other areas of expertise, complemented by empathy for team members whose expertise is in these areas, and some practical experience in working with people in the areas; and
- Ideally, also a breadth of interest and knowledge across a range of areas, some of which may be relevant to the project.

Tools for Creativity

The fourth pre-requisite for business creativity is in the area of tools for creativity – techniques that offer people who need to be creative frameworks to help them think through a problem, and processes to go through to generate creative ideas.

The range of tools that exists to assist people and teams in being creative is vast. One source consulted has articles on 186 different creativity techniques on its web site, under 5 headings (Idea Generation, Idea Implementation, Idea Selection, Problem Definition and Processes)[18]. One of these, DeBono's Six Thinking Hats, was mentioned in a number of interviews as being one of the techniques taught in courses on creativity in Irish higher education schools of art and design.

But the range of tools available to support creativity is actually much wider even than this.

- Large parts of the disciplines of business strategy, marketing, operations management and human resource management, as taught in colleges, are made up of frameworks that capture insights into how businesses, industries and markets work. The purpose of these frameworks is to assist managers in applying the insights to generate creative ideas to improve their businesses.
- Large parts of the practice of consultancy, business advice and indeed management development, are about bringing companies and managers through defined processes that will assist them in being creative, whether in terms of their strategy, their products or services, or their internal processes.
- Many engineering and technology disciplines have frameworks to assist them in creativity, particularly where design is seen as being important, as with, for example, business analysis in computing, and ergonomics in mechanical engineering.
- A large part of the discipline of design is about creativity, whether among designers, architects or others, and would be even if specific courses in creativity were absent. The same applies to the various art disciplines.

Tools for creativity do not produce creativity in themselves, but they can increase the likelihood that good creative ideas will emerge, and that these ideas are evaluated rationally.

18 This is taken from the website of Mycoted, a UK company that consults on creativity.

The discipline of Design teaches tools and techniques that can be applied to drive creativity both among designers and non designers. For example, techniques to underpin user centred innovation, such as mapping "Touch Points" (points where an organisation touches its customers), can be used to help bring design thinking into marketing, engineering and management practice.

Practising creativity

The fifth prerequisite for business creativity is that creativity should be practised. The more practice that people have at being creative, the more creative they are likely to be.

The more practice they have at being creative in one area, the more likely they are to be creative in another. This means that creativity is, to a significant extent, transferable from one domain to another, and it is worth promoting creativity in areas that have no major business application for the boost that it can give to peoples' creativity in the areas in which they work. Many businesses take advantage of this by supporting employees in studying part time, even where the course has no direct relevance to their work.

Innovation Management

The sixth requirement for business creativity is that there should be strong innovation management. The approach that businesses take to managing innovation has a major impact on the creativity of their staff, individually and in total. It is crucially important that the management team in a business understands the need for creativity and innovation, and the role of design in supporting innovation. It is also crucially important that it fosters and enables creativity, design and innovation in alignment with the business's goals. This is a pre-requisite for success in innovation, and failure in innovation management may often suppress both creativity and endeavours by the wider population of employees to innovate.

Common sources of failure are:

- Organisational culture unfriendly to creativity and innovation;
- A lack of permission for creativity and innovation;
- Broken reward systems that fail to reward success, and penalise good attempts that fail;
- A lack of space and resources to be creative[19].

Change management is one important component of innovation management. Change management refers to work on informing, training and assuring consent that is done to ensure that a planned change occurs efficiently and without undue organisational disruption.

Good innovation management is not sufficient to guarantee great outcomes, but poor innovation management guarantees failure. This makes skills in innovation management critically important to business creativity.

19 It is particularly common that day-to-day work pressures leave people with no time to be creative. Some of the companies best known for innovation (e.g. 3M and Google) are well known for allowing staff to devote a part of their time to pursuing projects they have chosen themselves.

2.3 Skills in Design

2.3.1 Professional Level Design Skills

Design is the process of moving from a creative idea to the creation of something of value. It is not just done by designers.

At professional level, it is possible to think of three broad categories of design, as summarised in Figure 2.3. These are:

- Design focused on excellence in technology and business efficiency, perhaps a device that is a "better mousetrap", a highly efficient piece of software, a technically excellent beer, a faster way of settling financial transactions, or higher quality or lower cost versions of any of those; also, marketing based on strategic and quantitative considerations;
- Design focused on achieving an excellent user experience, whether a desirable new electronic gadget, an easily navigated web site, an attractive and comfortable dress, a cinematographically excellent film or a living space that makes its occupants feel good; also, marketing focused on appealing to the user experience; and
- Design focused on artistic excellence, as in a painting, a piece of sculpture or a video installation.

Engineers and applied scientists tend to focus on the first of these three areas of design. The second is where professional designers tend to focus. The third is primarily the domain of artists. Marketers are generally to be found in one or other of the first two areas of design.

Figure 2.3 Three Broad Categories of Professional Level Design Skills

	Engineers and Applied Scientists	Designers	Artists
Main Design Focus	Technology Excellence and Business Efficiency	Excellence of User Experience	Artistic Excellence
Some Major Occupational Areas	Engineering Applied Science Computing Technology Business Analysis	Product Design Service Design Architecture Visual Design / Graphic Design Information Design Fashion Design Ceramics Design Film Disciplines Advertising professionals/copywriters	Painting Sculpture Video Installations
		Marketers	

These associations are not fixed. It is possible for engineers and applied scientists to focus on the user experience, and it is possible for artists to migrate into areas such as visual design, in part by learning to focus on user experiences. It is also possible for other business professionals, including marketing professionals and managers to bring a focus on user experience to bear.

This focus on the user experience by people who are not formally design professionals is often known as "**design thinking**". In some cases, it can allow a technology or business professional to take on the "designer" role. In other cases, it can be the key "T-shaped" skill component that helps other professionals to team effectively with a professional designer.

2.3.2 Designer Skills

In the interviews undertaken for the study, a variety of views were expressed as to what skills and qualities are central to the role of a designer. The description here, summarised in Figure 2.4, is a composite based on these.

Figure 2.4 Framework for Designer Skills

Almost all designers need a range of **technical skills** that are appropriate to their design discipline.

For example:

- Product designers usually have skills in Computer-Aided Design (CAD), ergonomics, materials and other capabilities at the boundary between design and mechanical engineering;
- Architects usually have skills in CAD, construction materials, structures, and other capabilities at the boundary with structural engineering; and
- Visual designers usually have skills in computer graphics, web site design and other capabilities at the boundary with digital media engineering, and typically know a considerable amount about printing.

All designers need an understanding of the **language** of the area in which they are working, a language which is usually more about the visual and physical expression of ideas than about verbal or written communication.

All designers need a high level of **creativity**.

A strong emphasis on understanding the **user experience** and applying this to design is important. At its most formal, this is encapsulated in the User Centred Design philosophy.

A focus on technical skills, design language and creativity is common to almost all higher education design courses in Ireland and internationally. However, there are a small number internationally that aim for a more conceptual approach that omits or downplays technical skills, on the basis that these can be provided by technicians and by other professionals, and that it is better to focus on higher order skills. The extent to which courses emphasise the user experience varies.

There are other areas of skill that are important to the success of the designer in a business innovation context, but again vary in the emphasis they are given on higher education design courses.

- An understanding of the market for what is being designed is critical. Design is a close-to-market discipline, in which people have to understand the market for the product or service they are designing, or the market for their own services or both.
- Design is a profession in which T-shaped skills, allowing its practitioners to work effectively with others, are important. In almost all areas, designers have to work closely with others. The types of people they have to work with vary depending on the design discipline.
    - Product designers work with engineers, marketers, other business specialists, and sometimes people from the behavioural sciences.
    - Architects work with structural engineers, surveyors, project managers, builders and others.
    - Visual designers may work with printers, digital media engineers, marketers, information designers, software engineers, usability specialists, technical packaging specialists and others. Some graphic designers frequently work with marketers and copywriters.
    - Film production is undertaken by people from a wide range of professional disciplines, including directing, cinematography, sound engineering, production design, post-production and others, all working together.

      This reflects the importance of team working in design and innovation.
- In some cases, the role of the designer goes beyond being an effective team worker, to a **leadership** role. This is often the case for architects, and usually the case for film directors, but it is increasingly common also for product and service designers. Design-led innovation is an increasingly commonly used approach to innovation, and designers typically play a leading role in this form of innovation.

2.4 Skills in Innovation

2.4.1 What Innovation Is

In business terms, an innovation is a change that creates economic value. There are four main types of innovation that directly create value:

- New and improved **products**, once they are bought by **customers**;
- New and improved **services**, once they are bought by **customers**, either by themselves or bundled with products;
- Changes in the way the company relates to the **business system** of which it forms a part that bring greater value to the business from its **customers**[20]; and
- Changes to internal **processes** and other characteristics within a business that improve its economic performance, whether through creating greater value for customers in terms of products, services and business system, or through increasing internal effectiveness and efficiency.

The first three of these rely on customer behaviour. If customers have not responded, no value is created, and no innovation has taken place, no matter how great the internal upheaval within the business.

The fourth relies on internal changes within the business. If the business has not changed in a way that makes it more valuable, then, again, no innovation has taken place.

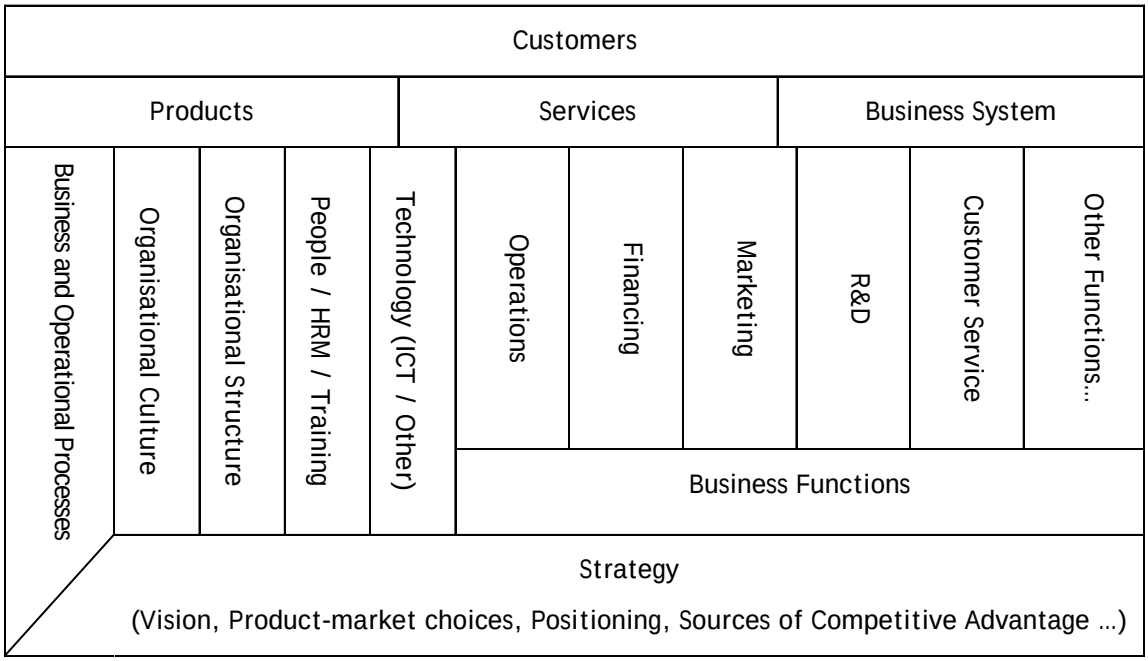
Innovation within businesses is a complex matter.

- Internal innovations typically involve changes to **processes** within a business, often complemented by changes in **organisational culture**, **organisational structure**, **people** (often mediated through human resource management practices and training) and **technology**. A technology can be as simple as a pencil and paper, or as complex as an information system or a new drug. Information and communications technologies usually play a role in process change, but other technologies can also contribute.
- Changes in any **business function** may potentially add value, and often process and organisational changes cross functional boundaries.
- Changes in business **strategy** can drive the creation of value in any other aspect of the business, and can in turn be driven by improvements in the processes used to generate and implement strategy.

20 One example of such an innovation is that the combination of Apple's iTunes music store and iPod range has dominated both online commercial distribution of music and portable media players in a way that was not achieved by the earlier mp3 players, which performed many of the same functions as iPods. At a less radical level, this category also includes changes to advertising, sales and marketing techniques employed.

A key implication of this is that innovation is not just the preserve of people working on new products and processes. It is relevant to all parts of every business. Figure 2.5 summarises the scope of business innovation described above.

Figure 2.5 The Wide Scope of Business Innovation



2.4.2 Sources of Innovation

There is no single source or method of generating innovation.

The **motivation** for innovation in a business usually comes from one, or some combination of, the following:

- Seeing an opportunity;
- Seeing a problem;
- Seeing a new way to connect ideas;
- Seeing a new way to connect with potential customers/users;
- Having a challenging objective that requires innovation to be achievable; or
- Going through a process designed to generate innovation.

Well developed systems of innovation are driven neither by technology push, nor by market pull alone, but by complex, integrated and heavily networked interactions between the supply side and the demand side.

The starting point for **inspiring** an innovation usually comes from one of the following:

- Strategy – Given what the business is trying to achieve, what sort of innovations does it need?
- Users – How can the business better serve the needs of users of its products and services? How can it better serve the needs of its internal "users", to allow them to perform better?
- Technology – Given that the business may have access to a technology, what can it achieve with that technology?
- Market – Given what is happening in a market, what sort of innovations does the business need to succeed?
- New perspective – If a business brings a new perspective to bear this can inspire new ways of looking at a challenge.

Moving from motivation and inspiration to an **invention** that can be implemented commercially is ideally a cross-functional process, for all but the most straightforward changes. It should bring together expertise in the user experience, expertise in applicable technologies and expertise in relevant markets. While expertise in all these areas can exist in one person, it more commonly has to bring together people from a range of backgrounds.

For example, invention of medical devices usually comes out of cooperation between clinicians with user knowledge and engineers with technical knowledge, complemented by an active involvement from people with market knowledge, who can assess the commercial opportunity and business risks.

Moving from invention to **innovation** is also a cross-functional process, requiring people from a range of backgrounds.

- Technology skills are required to develop the invention into a marketable product or service, or to develop a practical means of implementing an internal process change.
- Business skills are critically important, as the business clarifies the markets it will enter with new products and services, the business model it will use, how it will operate, what its launch strategies will be, and many other business issues, and then proceeds to implement its plans. Similarly, business skills are central to designing and implementing changes to internal processes.
- User experience skills remain important in informing business decisions, and in continuing to optimise the user experience.

2.4.3 Relevance of Disciplines to Innovation

There is a strong tradition, in Ireland and internationally, of associating innovation with disciplines in science, engineering and technology, to the exclusion of other disciplines. However, there is an increasing international acceptance that this oversimplifies matters, and that disciplines in the arts, humanities and social sciences also have important roles to play.

There are two main policy literatures on this.

- One policy literature emphasises the role of design, and of related "creative" disciplines including architecture, art[21], film and performance in innovation. This literature promotes an agenda of design-driven innovation, to complement the science and technology-driven innovation agenda represented by heavy public investment in science, engineering and technology (SET) research. It argues that there is a major need to boost the design content of innovation if businesses are to be competitive, and if developed economies are to thrive in the face of challenges from fast-growing economies such as those of China and India.

  For example, a recent paper by the Council for the Humanities, Arts and Social Sciences in Australia[22] distinguishes between Hard Innovation – driven by Science and Technology / R&D – and Soft Innovation – driven by design and architecture. By itself, Hard Innovation is seen as producing industrial products and commercial services, while Soft Innovation produces cultural products and performances. However, there is a broad middle ground of creative products and services that is driven by both Hard and Soft Innovation.

  In this framework, information and communication technologies (ICTs) are seen as enablers for both Soft and Hard Innovation.

- The other policy literature claims a role for the wider range of humanities and social science disciplines. Many of these disciplines clearly have important roles to play in innovation. For example:
  - Behavioural sciences, including psychology, ethnology, anthropology and experimental economics can be of great use in understanding how users relate to products in ways that are more complex than assumptions that they are simply rational economic actors, interested in price and quality, would suggest; and
  - English literature, history, modern languages, communications and some other disciplines clearly develop strong skills in communications of one sort or another, which are a necessary complement to the more visual and audio messages that the "creative" disciplines are suited to conveying. Just as with the creative disciplines, they have affinities with information technology in the areas of digital media and information design.

More generally, a case can be made that graduates from humanities and social science backgrounds may, in at least some cases, have superior generalist skills in areas relevant to creativity and innovation, such as international and multicultural perspectives, contextual saviness, formulation of poorly structured problems, and informed understanding of different modes of enquiry and their methodological implications.

21 It is perhaps useful to note here that fine art graduates in Ireland tend to go one of three ways – work as artists (sometimes alongside another job), migrate into design (or a design-related area such as film), or train as art teachers.

22 Between a Rock and a Soft Place – design, creative practice and innovation, CHSS Occasional Paper 5, April 2008.

However, we would suggest two cautions.

- There is a tendency in this literature for business disciplines to get lost in a gap between science and technology, on the one hand, and humanities, arts and social sciences on the other. As expertise in business disciplines is crucially important to innovation, and as business forms a part of humanities, arts and social sciences for Irish policy purposes, it is important that they should not get lost in this way (or hidden under a broader social sciences heading) in Irish policy.

  There is a tendency in the literature to move from analyses demonstrating the potential of specific humanities, arts and social sciences disciplines, to an assumption that all high quality investment in humanities, arts and social sciences has good potential to boost innovation. This is something of a stretch because: 1) Not all of these disciplines are of equal potential to contribute to innovation – they are identified as being valuable for the specific skills they teach, not so much for producing generalists; 2) The different areas of focus within a discipline can differ greatly in their potential; and 3) in at least some areas capable of making an important contribution, the numbers actually required to do this are likely to be low.

The overall message is that a range of disciplines in the humanities, arts and social sciences, are now recognised as having important roles to play in innovation, in addition to the disciplines in science, engineering and technology that have more traditionally been associated with innovation. The literature places a particular emphasis on the role of design, but a broader range of disciplines from the humanities, arts and social sciences can also contribute. Skills in business disciplines have a particularly important role to play.

2.5 Occupations and Industries

2.5.1 Introduction

This section reviews what skills in creativity, innovation and design are required across different types of occupation, and across different industries. It establishes a two-dimensional framework, based on five types of occupation and five types of industry.

It then addresses the skills in creativity, design and innovation associated with different areas within the framework.

The intention in presenting this is that a business would be able to position itself in the framework, in terms of the type of industry it is involved in, and the main types of occupations in which its employees are engaged, and that this would assist it in identifying which parts of the subsequent discussion of skills in creativity, design and innovation are most relevant to it. It would similarly assist policy makers concerned with a specific industry or occupation in identifying skills requirements in creativity, design and innovation for that occupation.

2.5.2 Occupations

We recognised earlier that innovation is relevant to all parts of every business. Everyone in the workforce works in an area where innovation may add value to the business.

In a relatively short study such as this, it is out of the question to analyse every occupation for the innovation-related skills it requires. Instead, we look at groupings of roles.

Seen from an innovation perspective, we observe five broad types of role:

1. Creatives;
2. Professional innovators;
3. Sporadic innovators;
4. Creative problem solvers; and
5. Innovators through work organisation.

Creatives are designers, artists, copywriters, photographers, architects, film occupations, illustrators, performers, writers, composers and people in similar roles. It is primarily designers who cross over to contribute to innovation outside the creative industries.

Professional innovators are those people whose core job is to contribute to innovation. They include engineers, technologists, researchers and scientists working on design, development and research. They also include many people in business roles concerned with innovation including product managers, strategy professionals, business analysts, business leaders, and many marketers, as well as behavioural scientists involved in innovation.

Sporadic innovators are the large number of people in managerial and professional roles who have a core job that take most of their time which is more about keeping things running than about innovation. As a part of this, they engage in creative problem solving from day to day, the cumulative effect of which is usually to drive progressive improvement. In an organisation that innovates effectively, they will also have bigger responsibilities to innovate within their own domain, and to work for innovation with others across the organisation, but their engagement with this is likely to be sporadic, rather than constant. Sporadic innovators often have difficulty in carving out enough time to contribute to innovation, in the face of day-to-day operational pressures.

Creative problem solvers are people in roles that are mainly about diagnosing problems and troubleshooting. Typical occupations include test laboratory scientists, many computer operations roles, engineers and technicians responsible for keeping production lines going, medical clinicians and quality assurance staff.

Innovators through work organisation are people whose core job is routine, and who might not have had a role in innovation in the past. Increasingly, however, businesses seek to get these employees involved in innovation through structured improvement processes, ranging from suggestion schemes to highly organised team based improvement initiatives. For these people, their contribution to innovation tends to come mainly through participative forms of work organisation, such as those now being promoted by the National Centre for Partnership and Performance.

2.5.3 Industries

In addition to being relevant across all occupations, innovation is relevant across all industries. As with occupations, in a relatively short study such as this, it is not feasible to analyse every industry for the innovation-related skills it requires. Instead we look at groupings of industries.

Seen from an innovation perspective, we observe five broad types of business:

1. Creative businesses, whose outputs range from fairly pure cultural expressions such as film, television and art, through the application of cultural expression for other business purposes, such as with advertising, digital media, and most graphic design and architecture, to deep involvement in innovation in other sectors, such as with product design businesses[23];
2. Businesses whose outputs are largely customised, relying on specialist skills to produce customised outputs (consultancy and investment banking, for example);
3. Businesses whose outputs are largely customised, but where the customisation is largely systematised, or dependent on other industries for creativity and design (e.g. construction);
4. Businesses producing largely standardised outputs, in which professional innovators account for a substantial share of all employment (software companies and pharmaceutical companies, for example); and
5. Businesses producing largely standardised outputs, in which professional innovators account for a modest share of all employment (most retailing and some manufacturing industry, for example).

Of course, the boundaries between these classifications are blurry, but they form a useful basis for discussion of skills needs.

2.5.4 Occupation-Industry Framework

Figure 2.6 presents a framework covering the range of occupation types and industries. As innovation is economically important across all industries, and as all occupations can make a meaningful contribution to innovation, any national strategy for innovation skills has to be drawn sufficiently broadly to cover all the “boxes” in the framework.

23 In this report, we take a definition of creative industries that excludes the mainstream software industry (which, in Ireland, has a particular focus on business applications), and cultural operations such as museums, which are sometimes included in definitions of creative industries. In the digital media context, this places businesses creating content and providing services in the creative industries, and developers of enabling technologies for digital media in the mainstream software industry.

Figure 2.6 Occupation-Industry Innovation Framework

Occupation Type / Industry Type	"Creative" (including design)	Professional Innovators	Sporadic Innovators	Creative Problem Solvers	Innovators through Work Organisation
"Creative"					
Customised Outputs, relying on Creativity and/or Design					
Systematised Customisation / Reliance on Others for Innovation					
Standardised Outputs, with Many Innovation-focused Jobs					
Standardised Outputs, with Few Innovation-focused Jobs					

The purpose in providing this framework is to assist businesses and their advisors in positioning themselves and their employees regarding skills requirements for creativity, design and innovation. Section 2.5.5 discusses what the skill requirements are over each part of the framework.

Figure 2.7 provides examples of occupations that fit into each box within the framework, with the exception of those that are very thinly populated.

Figure 2.7 Occupation-Industry Innovation Framework – Examples of Skill Requirements

Occupation Type / Industry Type	"Creative" (including design)	Professional Innovators	Sporadic Innovators	Creative Problem Solvers	Innovators through Work Organisation
"Creative"	Designers Architects Artists Most film professions Copywriters	Software engineers Marketers	Producers Managers	Production assistants	Promotions staff Clerical staff
Customised Outputs, relying on Creativity and/or Design	Web designers	Management consultants Technology consultants Financial engineers Mathematicians Researchers	Investment bankers	Traders	Clerical staff
Systematised Customisation / Reliance on Others for Innovation			Property developers Site engineers	Site managers	Construction workers Clerical staff
Standardised Outputs, with Many Innovation-focused Jobs	Industrial designers	Product design engineers Industrial chemists Chemical engineers Product Managers Researchers	Managers	Technicians Industrial trades Test laboratory scientists IT technicians	Production operatives
Standardised Outputs, with Few Innovation-focused Jobs	Retail designers Industrial designers	Software engineers Automation engineers	Managers	Technicians Industrial trades Test laboratory scientists IT technicians	Production operatives Retail workers

2.5.5 Skills Required by Type of Role

The skills required to reflect creativity, design and innovation across industry sectors, as shown in paragraph 2.5.3, are best described by types of role being undertaken.

(A) Skills Required by Creatives

Creatives in Creative Sector

Professional creatives are primarily employed in creative businesses. Teaching is also a popular destination for graduates in fine art.

There is a variety of types of business in the **creative sector**, in all of which most of those employed are from creative occupations.

- **Creative service businesses** – There are many types of creative service business, including graphic design, product design, web development, architecture, digital media development, and various other design disciplines, as well as advertising and promotional services. A considerable amount of content for television is also developed as a service by television production companies.

  Graphic design, architecture and advertising are well represented in Ireland, and are well established. Indeed, the country has significant exports of architectural services. Digital media, web development and television production services are less well established, but services are quite vibrant. There are very few successful Irish product design businesses, with some of those that operate also doing other types of work, and with Irish companies requiring product design services most often looking overseas.

  Creatives working in all these areas need technical and creative skills, specific to their role, as well as an understanding of the language of the medium in which they are working. In many cases, they work in teams, and require teamworking skills. In most cases, they work with people from other disciplinary backgrounds, and in addition to requiring strong communication skills, they need to possess horizontal **T**-shaped skills appropriate to the industry in which they are working. For example:

  - In advertising, graphic designers, audiovisual specialists and copywriters are likely to have to work together, and with clients.
  - An architect is likely to have to work with architectural technicians, structural engineers, planners, interior designers, people from a wide range of construction disciplines, and developers/clients.
  - In digital media, a designer is likely to work with digital media engineers and/or software engineers, and may also work with people from disciplines including animation, illustration, audiovisual/film, sound engineering, information design, usability, course design, and others. In addition they will most likely have client contact.

- A product designer is likely to work with engineers and marketers, within and outside the client organisation, and may work with people from various behavioural science disciplines and indeed intellectual property specialists.

Some creatives in service businesses also take on a leadership role, for example in managing a brand identity, or leading a product development process for a client in the case of a design-led product development assignment.

Those in management roles require management skills broadly similar to those required in any other small or medium enterprise (SME). Many of these businesses are owner-managed, and have much the same dependency on the management skills of the owner-manager as any other owner-managed business.

- **Businesses developing creative content and products on own account** – Some businesses develop creative content or products to exploit on their own account, in industries including digital media (e.g. e-Learning), television, and a range of craft areas including fashion, textiles, furniture. Similarly, some develop content for a client, but retain some exploitation rights. The skill requirements for creatives are similar to those in creative service businesses, but also require a high level of market understanding, and a practical knowledge of intellectual property management. Again, those in management roles require management skills broadly similar to those required in any other small or medium enterprise (SME). Many of these businesses are owner-managed, and have much the same dependency on the management skills of the owner-manager as any other owner-managed business.
- **Project-based businesses** –Ventures come together on a project basis, and are dissolved at the end of the project, particularly in film, and sometimes television, but also in many areas involving performance. While, for example, a post-production facilities house or the core of a production company may have a continuing existence, the cinematographers, sound engineers, production staff, director, writers, assistant directors, art designers, actors and others needed for a film are brought together for the production, and then disbanded. Continuity comes from a stream of projects, more than from a stable organisational shape.
- For their own roles, they need technical and creative skills, as well as an understanding of the language of the medium in which they are working. They also need very effective and flexible communication, teamworking, and indeed horizontal **T**-shaped skills to work productively with so many others with different areas of expertise, who change from one project to the next. Those in leadership positions, particularly the director and producers, but also those in lead technical roles, need leadership skills, and project management skills.
- In all roles, continuing learning is crucially important, to enable practitioners to progress up the career ladder that exists in many film disciplines, to improve skills, and to keep up with technological change.
- Creatives working in predominantly project-based industries are effectively running small businesses, so in addition to the technical and creative skills that they need to deliver value, they need a range of small business management skills.

- **Sole-operator businesses and micro-businesses** – Many creatives working in fine art and crafts trade as sole operators or in some cases leading micro businesses with no more than two or three people engaged. Some of these creatives have portfolio careers, with other sources of income, which may come from employment or from other commercial interests.
- In addition to the technical and creative skills that they need to deliver value, they need a range of business skills, in areas like pricing, cost management, sales, marketing and financial management.

It can be seen from the above that the set of skills required by creatives in the creative industry broadly matches the framework for designer skills set out earlier in Figure 2.4. In addition, a substantial share of creatives run, or have management responsibilities in, small or micro businesses, and require some business management skills for success.

Creatives in Other Industries without the "Creative" Tag

There are much smaller numbers of creatives employed in **industries without the "creative" tag**. We do not call these industries non-creative, as businesses in all industries rely on creativity for economic viability.

The key groups of creatives employed in these other industries are designers of various types.

- Some manufacturing companies employ product designers, and indeed the line between product design and design engineering can be difficult to draw. Some people from engineering backgrounds working in product development can have roles and skills very little different to those of product designers. Product designers are typically educated in a combination of design with elements of mechanical engineering.
- Most software requires user interfaces that, ideally, require a design input for usability, and so some software companies employ people with digital media design expertise.
- Some industries that rely heavily on design, particularly clothing and furniture, employ specialist designers, including fashion designers and furniture designers.

As with designers in other industries, they require the types of skill summarised earlier in Figure 2.4, in: technical skills; design language; creativity; user centred approach; market understanding; **T**-shaped skills; and leadership skills.

(B) Skills Required by Professional Innovators

Professional innovators are those people whose core job is to contribute to innovation. They include engineers, technologists and scientists working on design, development and research. They also include many people in business roles concerned with innovation including product managers, strategy professionals, business analysts, business leaders, and many marketers, as well as behavioural scientists involved in innovation.

At the same time, there are many engineers, scientists and business specialists who are less constantly concerned with innovation, and more constantly concerned with ongoing operational issues, who therefore fall into other occupational categories.

In addition to the other skills described below, *professional innovators* require skills in innovation management and leadership as they progress their careers.

Commercialising Product and Service Innovations

Key to skills requirements for professional innovators is the fact that commercialising inventions to turn them into new products and services being bought by customers requires three broad types of skill, with a fair degree of depth in each type.

- Technological and scientific skills and knowledge;
- Domain[24] skills and knowledge; and
- Business skills and knowledge.

Within each of these broad types of skill, there is often a need for a number of specialisations, and indeed for some people whose skills cross two or three of the broad areas in less depth.

Almost invariably, this means that close-to-market work on product and service innovation is a co-operative effort between people with a significant depth of skills and knowledge in complementary areas, along sometimes with some who have less depth but much greater breadth. Often, also professional innovators have to work with people from any of the other four types of occupation (*creatives, sporadic innovators, creative problem solvers and innovators through work organisation*).

The depth of skill and knowledge required in each area makes it almost impossible for even the most multi-talented high flier to cover all the bases by themselves.

Professional Innovators and Process Innovation

Professional innovators involved in process innovation within a business typically have specialist skills in either the technology or the process domain, and often quite a good knowledge of both. Typical occupations include business analyst, systems architect, software engineer, automation engineer, industrial engineer, change management specialist, project manager, internal consultant, chemical process engineer, food process engineer. What these have in common is that they have expertise in the process, technology and/or people aspects of process change.

Most process change in companies of any size is supported by ICT applications, which is reflected in this list of typical occupations.

24 Domain refers to the domain in which an innovation will be applied, such as in cardiac surgery, music distribution or funds management.

In most cases, *professional innovators* involved in process innovation work with people from other occupations (sporadic innovators, creative problem solvers and innovators through work organisation) who bring many of the domain and business skills required to the innovation process.

Professional Innovators Further from Market

The position with skills requirements in areas of research that are far from market is somewhat different and more nuanced, and depends on the intent of the research. If there is no clear path to commercialisation, or if the most likely path to commercialisation lies in simply licensing a technology, it can be possible for researchers to focus narrowly on scientific and technological matters, or on exploring an application domain without a need to have in-depth concern for how it might be addressed technologically. Even so, it is rare for research carried out by commercial entities to be divorced from the market to this extent, and at least the senior members of research teams are likely to have to work with others who have an interest in commercialisation, or the practical application of the technology. Moreover, even research that is relatively far from market is increasingly multi-disciplinary in nature, so researchers have to be able to work effectively with others from outside their discipline.

It is, however, important to recognise that research is often detached from innovation, which does not occur until an invention is commercialised. Research leading to a patent only becomes part of an innovation if the technology is commercialised. Moreover, a business that acquires or licenses a technology that it brings to market is no less an innovator because of the source of its intellectual property. There is a thriving global market in intellectual property generated by publicly and commercially funded research that has not found an immediate or exclusive application.

Professional Innovators in Different Types of Industry

Professional innovators are concentrated is industries producing Standardised Outputs with Many Innovation-Focused Jobs (Figure 2.7), such as software products and biopharmaceuticals.

There are also significant numbers in industries producing Customised Outputs, relying on Creativity and/or Design, particularly firms providing consultancy services in areas from management consultancy to engineering consultancy. Companies producing Standardised Outputs with Few Innovation-Focused Jobs often have a core of professional innovators based in their information technology function and/or in their marketing function.

Key Skills Implications

The key skills implications are that:

- Depth of specialist skill and knowledge is important among most *professional innovators*, whether it is in the technological and scientific area, the domain in which the innovation will take place, or in the business skills and knowledge required.
- As the work of *professional innovators* is characterised by co-operation between people from very different disciplinary backgrounds, there is a major need for strong generic skills and horizontal **T**-shaped skills.

- There is some space in innovation for people with cross-disciplinary skills, but less depth, for roles such as product management, which can require a balanced combination of technology, domain and business skills.
- Skills in innovation management and team leadership become increasingly important as *professional innovators* advance their careers.

(C) Skills Required by Sporadic Innovators

Sporadic innovators ideally watch for opportunities to innovate all the time, but spend only a part of their time on innovation-related work. Most of their time is spent keeping day-to-day operations running.

They can bring a considerable amount of domain knowledge, business knowledge and/or technology knowledge to their work on innovation, and can draw on their network of colleagues and contacts to supplement this, but often have to draw on other sources, such as IT specialists, marketing specialists, operations management specialists or designers to supplement this. They often also draw on the knowledge and expertise of their staff, and may delegate work on innovation to individuals and teams.

Key skills they require for innovation are:

- Existing skills and knowledge from their day-to-day role;
- Generic skills in communications, teamworking and problem solving;
- Horizontal **T**-shaped skills to work with people from other disciplines;
- Leadership skills; and
- Elements of innovation management.

(D) Skills Required by Creative Problem Solvers

Creative problem solvers are people in roles that are mainly about diagnosing problems and troubleshooting, in areas such as laboratory, computer operations, quality assurance or keeping production lines going. While much of this work can be routine at lower levels, it includes a significant degree of problem solving, which is greater at higher levels. This requires a combination of strong technical understanding with very strong problem solving skills. The systems that these people deal with are, on the whole, becoming increasingly complex, bringing an expanding need for creativity in problem solving, and the capability to draw on different perspectives.

The roles typically require good teamworking skills, as much of this work is done in a teamworking environment. They also require strong communication skills, and some horizontal **T**-shaped skills, to work with others with an interest in the problems they are responsible for solving.

Illustration – Creative Problem Solving in a Beverage Company

An Irish beverage production operation has a highly automated production process. The process is managed by teams of people who mostly have many years experience, originally recruited with no qualifications, or having technical craft qualifications in as electricians or fitters, or in maintenance.

The demands of the work have changed radically over the years, from being mainly manual to being mainly about keeping the production process going without interruption, maintaining product quality, and avoiding waste. Most of the manual aspects of the work have been automated out of existence.

At its core, the work is knowledge work, concerned with identifying emerging problems, and resolving them before they can damage production. It requires technical skills and knowledge in electronics, computing, mechanical engineering and beverage processing. Some of the work is routine – including setting up production runs, monitoring quality and undertaking preventive maintenance. However, when signs of a problem emerge, it is necessary for the team on duty to diagnose the problem, and develop and implement a solution. This can require significant creativity. This is a cooperative effort, drawing on the expertise of the different team members.

Workers in this area also contribute to improvement initiatives that may also involve professional engineers and scientists

(E) Skills Required by Innovators through Work Organisation

Organised inclusive initiatives to improve business performance most often focus on improving operating processes, but can also focus on innovating in products and services. At their most advanced, these bring teams together to identify and implement possible improvements. These can operate at the level of existing teams or departments, but also frequently operate across functions, and across levels within the organisation.

The key skills that those involved in this sort of innovation require are the skills that they need to carry out their existing role effectively, a significant degree of creativity and openness to thinking differently, and also strong generic skills, in teamworking, communication and problem solving. Those leading initiatives of this sort require leadership skills.

Underlying these generic skills, literacy, numeracy, computer user skills and English language skills are valuable, if not always present at lower occupational levels. While they are not preconditions to taking part in this sort of innovation, weakness in these areas can pose a handicap. Initiatives focused on addressing such weaknesses can play a useful role in promoting innovation.

As they become involved in initiatives to improve business performance, *innovators through work organisation* often have to learn analytic techniques to assist them in their work.

Illustration – Work Class Manufacturing in an Industrial Products Company

An Irish company making tools for industrial applications was interviewed for the Expert Group on Future Skills Needs study on In-Company Training, published in 2000. The company had come under pressure on price and quality in the international markets that it served. It badly needed to manufacture its products more efficiently, and to become more agile in producing short runs of its increasingly diverse and innovative product range.

With support from Enterprise Ireland, it embarked on a World Class Manufacturing initiative, with a strong focus on making the most of the capabilities of its shop floor assembly workers, who accounted for the majority of its workforce. Changing from a traditional top-down operations management approach, it introduced cross-functional teams to identify ways to improve operational efficiency and to help make products easier to manufacture. It introduced self-directed teamworking, with teams moving flexibly from one product line to another in response to variations in market demand.

The success of the initiative depended heavily on the capability of employees to work productively in teams, to solve problems and to communicate effectively. There were concerns about how well this could work, as many employees had low levels of educational attainment, and many had problems with literacy. The company responded to this issue by providing training to employees, and supporting those interested in improving their education.

The initiative was highly successful, increasing efficiency, allowing the company to produce short product runs economically, and allowing product innovations to be brought into production at short notice.

Eight years later, despite increasing costs, adverse exchange rate movements and increasing competition from low cost locations, the company still has its manufacturing operations in Ireland, and is further investing in manufacturing efficiency and product innovation.

Table 2.8 Examples of Skills Requirements by Type of Role

Type of Role	Core Skills	T-Shaped Skills: Ability to understand and work with:
Creatives	Industrial design	Users, engineers, marketers, regulatory authorities, behavioural scientists, managers …
	Architecture	Structural engineers, planners, builders, developers …
Professional Innovators	Software engineering	Users, business analysts, product managers, sales, marketing, customer support, telecommunications engineers, managers …
	Marketing	Graphic designers, engineers, copywriters, events managers, product managers, product designers, managers, IT specialists …
Sporadic Innovators	Managers	IT specialists, marketers, operations managers, designers, staff reporting to them …
Creative Problem Solvers	Operations technicians	Engineers, operatives, quality assurance staff, supervisors, managers, industrial scientists …
	Medical laboratory scientists	Clinicians, pathologists, nursing staff …
Innovators through Work Organisation	Machine operatives	Supervisors, technicians, engineers, industrial scientists …
	Retail staff	Supervisors, customers, managers …

Hybrid Product/Service Operations

One key area of innovation for Ireland is where manufacturing operations of overseas-owned corporations develop service offerings, which in many cases eventually replace the original manufacturing operation. Typical services include supply chain management, financial operations, customer service, marketing, product development services, administrative functions, sales and hosting. While these functions are not new in themselves, Irish operations have to find innovative ways to implement them so as to add sufficient value to justify their being located in Ireland.

2.6 Innovative Companies

An innovative company is one that develops, and successfully brings to market, new and improved products and services. It also continually improves its internal working processes in both small and big steps.

To achieve all this successfully, it is strong in a number of areas.

- It has a clear strategic vision of what it is trying to achieve, where it can attain and sustain competitive advantage, and broadly what it needs to do to achieve this.
- It is good at innovation management, empowering, resourcing and rewarding its employees to be creative and innovate in ways that further the company's objectives.
- It involves most or all of its employees in innovation, in one way or another.
- It brings a diverse range of backgrounds and experiences together to solve problems and to innovate, cutting across organisational boundaries. It is good at bringing together business, technology and user perspectives to creative ideas for innovation, to turn them into inventions, and to commercialise inventions into innovations.
- It is open to the world outside the business; is good at understanding user needs and wants; and is good at finding, absorbing and leveraging ideas created elsewhere.
- It has deep expertise that gives it the base of understanding that it needs to be creative and innovate.

The sort of people an innovative company needs are:

- Leaders who are good at setting a strategic direction, can establish an innovation-friendly culture, and who are good at innovation management;
- Employees at all levels who have strong generic skills, particularly in communications, teamworking and problem solving, and who more generally have the skills required to cooperate with others who have complementary skills;
- People with a good understanding of how to apply relevant technologies, with skills in application of information technology being required almost universally, and skills required in other technologies depending on the specific nature of the business;
- People with a good understanding of the market, both in broad aggregate terms and in terms of the specific needs and wants of users of the product or service; and
- People with a strong grasp of business: how to commercialise a product or service, and how to leverage this to build a strong, profitable and sustainable business.

Illustration – Skills for the Computer Games Industry

The computer games industry is a fast-growing global industry that produces products that operate on a range of platforms, from consoles and PCs to mobile devices, and based on models that include sale, subscription, payment by usage or advertising. Delivery may be on hard media (CD/DVD) or online.

Core skills required to create games are in software development and programming, and in visual design, and it is essential that specialists in each of these areas can work effectively together. Sound is also important, with music and voice acting making major contributions to the user experience.

Depending on the game, specific skills may be required in areas such as Internet or telecommunications engineering, and in animation. In a mobile or subscription context, expertise in billing systems can be important. Expertise in the psychology of games and user interfaces is also important. Game design is itself an important discipline.

Expertise in an array of different cultural areas is also important – games are now one of the leading forms of cultural expression, and each sits within a much broader cultural context, both visual and written. Expertise in storytelling is required to generate satisfying game storylines and back stories.

As games such as Massively Multiplayer Online games (MMOs) increasingly have internal economies, there is a corresponding requirement for economic expertise to keep these economies stable, and manage inflation.

Business expertise is essential, to obtain the best return on a product, whether it is a major console project that has cost several million euros to develop, or a small project relying on online advertising to generate a return.

Particularly at the higher end of the market, customer service is critically important to the user experience, and as a means of providing feedback for further innovation. Web sites, moderated discussion forums and (for some games) in-game Game Masters play important roles in this.

Critically important to innovation is bringing all of these areas of expertise together to produce a satisfying game that will generate a good return on investment. This requires deep skills in the areas described above, as well as the horizontal T-shaped skills to work creatively and innovatively with people from each other skill area. People working in the industry need to have at least a basic understanding of a range of areas of expertise, and people with deep knowledge in more than one area can often bring considerable extra value.

In terms of the framework presented in Figure 2.6, the computer games industry is a creative industry, employing substantial numbers of creatives and professional innovators, and also some sporadic innovators (managers) and creative problem solvers (customer support staff).

2.7 Conclusion

This chapter has examined the skills required for creativity, design and innovation, and has found that they are needed in all industries and in all occupations. While there is some variation between occupations and across industries, some universal points emerge.

- Depth of skill and knowledge is important to creativity and innovation.
- Creativity relies heavily on finding new ways to combine existing ideas. In skills terms, this means that the capability to work well with people whose deep skills lie in other areas is critical.
- All other capabilities have to be underpinned by strong generic skills in areas including communication skills, teamworking and problem solving.
- Creativity and innovation are influenced heavily by the culture of the organisation, and how innovation is managed and led.

Chapter 3 How Ireland is Doing

3.1 Introduction

The skills of the Irish workforce in creativity, design and innovation are innate to an extent, but are also heavily influenced by their educational and working background, and their life experiences. Experiences that give people practice at being creative, and reward them for it, enhance their creativity. Experiences that give no opportunity or reward for creativity do the opposite.

Likewise, many of the more tangible skills required for creativity and innovation are enhanced by practice and through being rewarded, and are retarded and undervalued if they remain unpractised and unrewarded. Generic skills are developed through practice in communicating and solving problems, and through undertaking projects and assignments in teams. Horizontal T-shaped skills rely on a knowledge and empathy for complementary disciplines and their practitioners that is only likely to be gained through working together.

3.2 Primary Education

3.2.1 Best Practice

International best practice in primary education emphasises child centred approaches to learning that, in addition to developing the "three Rs", also develop knowledge and skills in a broad range of other subject areas including natural sciences, social, environmental and political sciences, health, history and languages. It also supports developing broader skills in areas including higher order thinking, independent learning, social skills and collaboration. There is an increasing emphasis on quality assurance.

3.2.2 Irish Practice

The Irish primary curriculum has a history of being responsive to international educational trends. The most recent revision was introduced in 1999, drawing heavily on international experience.

The curriculum seeks to promote a range of skills that map directly to key skills required for innovation. These include:

- Higher order thinking skills – skills in summarising, analysing, making inferences and deductions, and interpreting figurative language and imagery;
- Inquiry-based learning – learning through investigating a topic, rather than just taking what the teacher or textbook has to say;
- Project-based learning – using projects as a vehicle for learning;
- Cross curricular learning – making connections across different subjects within the curriculum, for example with projects that relate to more than one subject;
- Transfer of learning – making links between topics learned; and
- Collaborative learning – i.e. team based learning.

The subjects on the primary curriculum are also fairly well balanced in terms of underpinning the range of skills that will eventually be required for creativity and innovation in the workforce, with maths, science, visual arts and English all being given reasonable weight, as well as providing the foundations of a broader education, in areas such as social studies, history and geography.

3.2.3 Direction of Policy

There is a Review of the Primary Curriculum currently underway. This has found that the curriculum has had a positive impact on children's learning, that they enjoyed the subjects and the use of active learning methods, and that this was important in contributing to successful learning and self esteem. However, the report criticises an over reliance on textbooks and inadequate use of ICT. It identifies a need for greater differentiation strategies, more use of group work and pair work, and greater attention to the promotion of higher order thinking skills.

The NCCA has said it will respond "through the development of a school network. Teachers involved in the school network will work on shaping the responses to the challenges identified … This network will comprise clusters of schools, each potentially dedicated to one project (for example, teaching methods).

"Teachers participating in the network will have opportunities to work with and learn from teachers in other schools within a single cluster, as well as schools in other clusters. Through this network the NCCA will work closely with teachers in order to develop a number of resources and support materials to support teaching and learning in primary schools."[25]

3.2.4 Conclusions

A clear and consistent assessment emerges from the interviews undertaken for this study, and from both the Review of the Primary Curriculum and a sample of Whole School Evaluations published by the schools Inspectorate.

It is that Irish primary education is essentially on the right track to prepare students to be creative and innovative, although there are still some problems with implementation of aspects of the curriculum that support this. Overall, the primary system is seen as being good at opening students' minds, developing their creativity, preparing them to work collaboratively and teaching them to learn independently.

Some interviewees highlighted resourcing constraints that they say can impact negatively, by limiting access to ICT resources, and by slowing the adoption of new teaching approaches.

25 http://www.ncca.ie

3.3 Second Level Education

3.3.1 Best Practice

The general shape of reform in second level education internationally is towards developing generic skills and an understanding of social, economic and civic contexts among students, alongside the hard content of the various subjects studied in school. Skills and knowledge in these areas are important to developing creativity and the capability to be innovative.

3.3.2 Irish Practice

Introduction

The contribution of second level education in Ireland to promoting creativity and innovative capability among students is a complex matter.

- On the one hand, considerable work has gone into developing the second level curriculum, much of it supportive of developing creativity and higher order thinking skills among students.
- On the other hand, one of the most consistent messages from interviews with industry and higher education undertaken for the study is that they see problems with the preparedness of school leavers to contribute to innovation.

Reform of Second Level Education

Second level education underwent significant reform in the 1990s, with the introduction of the Junior Certificate in 1992, the introduction of the Leaving Certificate Vocational Programme and the Leaving Certificate Applied in the mid-90s and the mainstreaming of Transition Year. Since the mid 1990s, many Junior Certificate and Leaving Certificate courses have undergone reform, most recently the Leaving Certificate courses in Technology and Graphic Design which will first be examined this year. Revised Leaving Certificate syllabuses in Art, Economics, Agricultural Science, Engineering Technology and Architectural Technology are awaiting implementation. Implementation of the revised Art and Technology subjects requires significant investment in equipment and professional development for teachers, and the resources for this are not currently available.

There is ongoing work underway on new developments at second level, including:

- New senior cycle subjects – Politics and Society, and Social Personal and Health Education;
- Project Maths, which is introducing major reforms in Mathematics at junior and senior cycles, currently in 24 Project Schools, with mainstream implementation in all schools starting in 2010; and
- Rebalancing syllabuses at junior cycle.

Support for Creativity in Second Level Education

There is much about Junior Certificate and Leaving Certificate syllabuses that focuses explicitly on creativity. The Music and Art syllabuses focus directly on creative skills in the musical and artistic domains. Language courses require students to respond creatively in examination papers. A range of courses, amongst them Home Economics, require the use of design skills. Examinations in many

subjects test creative and evaluative skills, for example: case studies in business subjects; unseen poetry in English; composition; and writing articles in response to unseen text.

The State Examinations Commission's Manual for Drafters, Setter and Assistant Setters asks examiners to test against a range of objectives. The objectives vary in significance from syllabus to syllabus, and accordingly vary in the manner in which they are assessed in state examinations. Four of the objectives are particularly relevant to the practice of creativity and innovation, as identified in this report. The four areas are:

- **Analysis**, which is "the ability to understand the organisational structure of information";
- **Synthesis**, which "involves the creative application of prior knowledge and skills to produce an original entity";
- **Evaluation**, which is "the ability to judge the relative value of information based on prior knowledge"; and
- **Origination**, under which "one might construct a new theory or create a new ice-skating routine, one might arrange, build, combine, compose, construct, create, design, formulate, initiate, make, modify, originate, redesign, or troubleshoot".

The seven Students' Tasks in the Leaving Certificate Applied make significant demands on students' creativity.

Support for creativity has been, and continues to be, an important focus for reform of the second level system. One of the major ways in which this is expressed is through increased emphasis on practical work and project work, with coursework components, assessed for examination purposes, being introduced in many subjects. For example, in the new Design and Graphic Communications subject, student skills in design are assessed through a student assignment (in 2009, designing an MP3 Player Docking Station (at Higher Level) or an Audio-visual Remote Control unit (at Ordinary Level)).

Support for Developing Capabilities in Creativity and Innovation from Outside the Classroom

In implementing the curriculum, schools are encouraged to engage with local community interests, to engage in field trips, and to work with employers to give relevance and impact to what is learned in school. Of particular relevance to creativity and innovation, 12,000 students engage annually in the Student Enterprise Awards, and 5,000 take part in the Young Social Innovators programme. Other key initiatives include Junior Achievement and the BT Young Scientist Exhibition. A number of youth work organisations undertake valuable work in this area, including, for example, ECO-UNESCO Clubs.

Critiques of Development of Capabilities in Creativity and Innovation at Second Level

Despite the focus on developing capabilities required for creativity and innovation in the curriculum and examinations system, substantial concerns in this area were expressed by many of those interviewed for this study. Academics from both university and Institute of Technology sectors (with the exception of those in Art and Design) said that a large proportion of new students are only prepared to learn what is presented in lectures, and perform poorly when asked to learn

independently, to solve problems that are not very well structured, or to work collaboratively with others. Interviewees from industry and from industry organisations agreed with the higher education perspective. Interviewees from both higher education and industry attributed these problems to the way in which many second level students and teachers respond to the public examination system.

This perspective on the Leaving Certificate is not unique to those interviewed. For example, participants in the NCCA's consultation on Developing Senior Cycle Education indicated that the Leaving Certificate:

- "assesses a very narrow range of learning, mostly the ability to recall and write information;
- does not adequately assess the skills and capabilities of learners;
- dominates teaching and learning at senior cycle by rewarding product over process;
- puts undue pressure on students to perform over a concentrated period of time at the end of senior cycle; and
- may damage students' self-confidence and affect their attitude to future learning."[26]

Role of Public Examinations

The Leaving Certificate plays a central role in the Irish college entry system. It has to be seen to be fair and uniform, to judge people on their individual merits, and to be free from perceptions that it could improperly be influenced by non-objective factors. It performs excellently in this regard. The need for these characteristics in the system is greater in Ireland than in many other countries because of the near-monopoly the publicly funded higher education system has over courses in disciplines that are in high demand, and therefore over access to various professions, and because of a history of great sensitivity among the Irish electorate to perceptions of possible improper influence in the allocation of publicly-controlled opportunities and resources. There is no sense from the interviews undertaken that it would be practicable to meet these requirements with anything other than a system dominated by a terminal public examination.

It is well established internationally that the nature of assessment can impact greatly on teaching and learning in the classroom, so it is to be expected that an externally assessed terminal examination, such as the Leaving Certificate would do much to shape teaching and learning at second level, particularly at senior cycle. Specifically in Ireland, there are strong pressures in the system for students to attain high points, and it is fairly well recognised that this leads a significant proportion of schools and parents to encourage an undue focus on rote learning, rather than the real understanding required to underpin capabilities in creativity and innovation. This tendency appears to be at the root of the criticism heard from industry and academics, and indeed seen in the report on the consultation on Developing Senior Cycle Education referenced earlier.

26 Developing Senior Cycle Education - Report on the consultative process, NCCA, 2005

3.3.3 Direction of Policy

Direction of Reform at Second Level

As outlined earlier, there has been a history of reform at second level since the early 1990s. In recent years, this has increasingly emphasised not only embedding the development of skills relevant to creativity and innovation into syllabuses, but also managing the constraints inherent in the Leaving Certificate as an externally set, high stakes terminal examination.

- A key problem with awarding grades only on the basis of a terminal examination paper is that there is little scope to encourage or give credit for independent learning, or for the sort of project work that develops skills in information processing, creative and critical thinking, communicating, working with others; and being personally effective. However, reformed second level syllabuses increasingly require project working, with a significant proportion of the marks in the subject being awarded for project work. In most cases, the tendency is to award 20 percent of marks in this way, which is seen as being enough to ensure that schools and students take the exercise seriously, without being enough to encourage parents or teachers to give students excessive assistance. In the case of the new Design and Communication Graphics course (which replaces Technical Drawing), project work is being undertaken in a CAD[27] system that records each step taken, making it possible for examiners to audit the project work. In this case, 50 percent of marks will be awarded for the project.
- According to a number of key interviewees, questions on many papers are predictable within fairly narrow limits. There are strong pressures in the system towards making Leaving Certificate papers predictable, with considerable public criticism from students, parents and teachers any time a paper asks an unexpected question, despite it being within the syllabus and consistent with the design of published sample papers. These pressures have become stronger over time.

  This means that many questions that give the appearance of testing problem solving skills seem to mainly test students' ability to reproduce the solution to one of a small repertoire of problems that they have already rehearsed on many occasions, perhaps with slightly different numbers (in the case of numerical problems). Aside from assuring that students cover the curriculum, less predictable papers would test students' problem solving skills, which would in turn ensure that they learned these skills. Problem solving skills are central to creativity.

  As an approach, this is now being trialled at second level as one of the innovations in Project Maths, an initiative starting with 24 schools in September 2008, and which is planned to be mainstreamed from 2010. One of the changes associated with the Project Maths is that, after studying a revised curriculum, students from participating schools will sit a separate paper, designed to test mathematical skills in familiar and unfamiliar contexts. Marking schemes for the old-format and Project Maths papers will be designed to ensure that students are neither advantaged nor disadvantaged by taking the new style of paper.
- Another problem with the Leaving Certificate is the way that the subject structure forces it into something of a straitjacket, with little scope to address an area that might be of educational value, without having to add a whole additional subject. A number of short courses are being developed, which are likely to be worth half a subject each when calculating points for college entry. This will bring considerably more flexibility to the system, and should facilitate the introduction of subject matter that is relevant to creativity and innovation in industry, that could

27 Computer-Aided Design

not otherwise be accommodated within the system. Work is currently underway on developing courses in Enterprise, Music Technology, Art Technology and Psychology, all of which have obvious relevance to the theme of Creativity, Design and Innovation.

Reforms such as these in the Leaving Certificate are contributing to making space for curriculum reform to be effective in developing skills relevant to creativity and innovation.

The National Council for Curriculum and Assessment (NCCA) has developed a framework of Key Skills for senior cycle which very much reflects the generic skills that are critically important in underpinning creativity and capability to be innovative. These are:

- Information processing;
- Creative and critical thinking;
- Communicating;
- Working with others; and
- Being personally effective.

For the last two years, NCCA has been working with a network of schools to investigate embedding these skills in English, Gaeilge, French, Spanish, Mathematics, Chemistry, Physics and Biology, as a part of its Review of Senior Cycle. It envisages rolling this out to the wider population of schools.

Aside from the more fundamental reforms described above, it should be noted that a number of the new curricula that have been developed, have a particular relevance to the theme of Creativity, Design and Innovation.

- A new curriculum in Art is awaiting approval of funding by the Department of Education and Science. A number of those consulted for the study feel that the existing curriculum is badly outdated, and that the new curriculum is required urgently to improve design literacy among school leavers. This will complement the new Design and Communication Graphics course, and also the proposed Art Technology short course if implemented.
- Revised syllabuses have been developed in Leaving Certificate Architectural Technology (formerly Construction Studies) and Leaving Certificate Engineering Technology, both of which have a significant focus on design technology. It is urgent that these should be implemented.
- A new full subject in Politics and Society is being developed, which, along with the proposed short course in Psychology, has the potential to develop a better understanding of the behavioural sciences among school students.

Reforming Teaching and Learning

While the current nature of the Leaving Certificate is the major obstacle to reform of second level education, the purpose in reforming the Leaving Certificate is to facilitate change in teaching and learning. This requires resources to develop and diffuse new approaches, to provide appropriate

training and supports, and to provide new or improved infrastructure such as laboratories and information technology resources.

A number of interviewees identified resourcing issues as slowing down reform of second level education, delaying the adoption of new curricula, and making improvements for much of the system dependent on the goodwill of teachers to engage in training and development initiatives outside the scope of their contractual obligations.

A bottom-up approach to reform of teaching and learning, based on voluntary involvement by teachers and schools interested in leading system change, has gained significant traction, and it seems likely that this will reduce the cost of progressively implementing reforms. Even so, there will be a need for ongoing investment in developing teacher skills and knowledge, and in the resources required to support effective learning.

3.3.4 Conclusions

There are problems with the way in which second level education impacts on the creativity and innovation capability of Irish students. These problems have a history of being difficult to tackle because of the influence of public examinations on the behaviour of parents, schools and indeed students. This is despite the fact that the need for skills relevant to creativity, design and innovation is to a great extent reflected in syllabuses and in the objectives set out for examiners by the State Examinations Commission.

The general shape of reform to the second level system has favoured the development of skills relevant to creativity, design and innovation. This has been particularly the case in recent years, with an increasing focus on project work (much of it with a substantial creative and/or design content) assessed for public examination purposes. The Project Maths initiative, due to be mainstreamed from 2010, is innovative in many ways; of particular relevance here is the way in which it seeks to influence school, parent and student behaviour to improve learning in ways that should improve students' capability to leverage maths skills in the context of creativity and innovation.

Many of the key recent and current reforms have not yet been in place for sufficiently long to impact on higher education and industry views of second level education.

Given the deficiencies in the capability of Irish students to engage in creativity and innovation reported by higher education and industry, it is important that the process of reform should continue strongly, and that lessons learned from successes should be leveraged across other parts of the second level system with a minimum of avoidable delay.

Specifically from a design perspective, the launch of the new course in Design and Communication Graphics is very welcome, and it is urgent that the revised syllabuses developed in Leaving Certificate Architectural Technology (formerly Construction Studies) and Leaving Certificate Engineering Technology, both of which have a significant focus on design technology, should be implemented.

The introduction of the new Leaving Certificate curriculum in Art is urgent.

There is a need for continuing investment in developing and improving teaching and learning, to allow reform of second level education to continue.

3.4 Further Education and Training

3.4.1 Best Practice

Internationally, further education and training takes place in a variety of contexts - in colleges, training centres, the workplace and sometimes community contexts. This pattern is similar to that in Ireland, although significant colleges are more prevalent than in Ireland, where much of the college-based provision is distributed around a relatively large number of small further education colleges, some of which are integrated with second level schools. In many cases (as with for example community colleges in the US), there can be ambiguity as to whether providers are more comparable to Irish further education providers or to Institutes of Technology in their original role of providing two year certificate courses and apprentice training. The small scale of many Irish providers of further education and training poses challenges in developing and maintaining a community of practice that engages these providers, potentially making it difficult for them to look beyond formal quality assurance processes in evaluating their own performance relative to best practice.

Consistent with school and higher education levels, best practice in further education and training in relation to skills in creativity, design and innovation hinges on:

- High quality learning in the core content of the course, with appropriate links being drawn between related content from different courses;
- Developing generic skills in areas including communication, problem solving and teamworking skills;
- Encouraging students to reflect on what they are learning so that they go beyond learning the skills to do a narrow well-defined job, whose content may change beyond recognition within a few years;
- Connecting students with the world of work, to help them to put what they learn into an applied context;
- Connecting students with complementary disciplines, preparing them to work with people from other backgrounds; and
- Fostering creativity, market awareness and business understanding, across all disciplines, but particularly in creative disciplines.

3.4.2 Irish Practice

The further education and training sector is made up of a diverse range of providers of education and training, with most of the certified education and training being certified by FETAC. Key among these in the State sector are further education colleges, providers of literacy and basic education and training (much of it for groups with special needs), FÁS, Fáilte Ireland, the apprentice training activities of many of the Institutes of Technology. There is also significant private sector activity at this level, particularly in the workplace, but also by private education and training providers.

Certified further education and training takes place at Levels 1 to 6 in the National Framework of Qualifications. Under the framework, the scope for creativity and autonomy is limited at Levels 1 to 3, becomes significant at Level 4, and is more pronounced at Levels 5 and 6.

FETAC, FÁS and Fáilte Ireland exercise a considerable degree of influence over provision that lies outside their direct control. Since its establishment, as a legacy from the work of the National Council for Vocational Awards, FETAC has a pervasive influence on provision in further education colleges, through defining awards and standards, and through its validation processes. This influence is now intensifying in other provision, as FETAC harmonises standards across the range of providers that offer courses leading to FETAC awards.

FÁS and Fáilte Ireland influence not only the courses they provide themselves, but also apprentice training at the Institutes of Technology.

The interview evidence is that there is considerable variation in the extent to which further education and training courses develop creativity and innovative capability among their students. This assessment is based on an overview of varied types of provision in both education and training contexts, particularly from Levels 4 to 6, and the points that follow do not apply equally in each context. The points are raised, not as a criticism of any provider, or as an attempt to provide a detailed analysis of this very complex sector, but as a flag to encourage those involved in provision and assessment of further education and training to reflect on their own practices.

- Some courses are focused tightly on learning a skill, or a set of skills, and make only a limited effort to develop broader skills in communication, problem solving and teamworking, or to encourage students to reflect creatively on what they are learning.
- In many cases, what is done in this area is segregated into one or more generic modules. Where the course provider does not link the delivery of these modules to the broader subject matter of the course, interviewees say that this makes it less likely that students will engage effectively.
- Many courses involve a significant amount of project work, which requires independent learning and some degree of creativity. Where projects are conducted in groups, they can promote teamworking.
- There is a significant concentration of courses in creative disciplines in the sector, which generally have a strong and direct focus on creativity. There are many courses in art, most focused on preparation of portfolios for entry into higher education courses in art and design. There are also significant numbers of courses in areas including new media, music, sound,

video/audiovisual, animation, journalism, radio and television presentation, performance, e-business, community development, tourism, event production, interior design, fashion design, software development, international trade and sales & marketing among others.

- Many courses in the sector include work experience, helping students to put their studies in context, and making it more likely that they will be able to apply what they learn creatively.
- Some courses in the sector, for example in childcare, include a formal requirement to reflect on practice, which is designed to drive self-awareness and improvement, forming a good basis for creativity and innovation.
- A few courses in the sector include cross-disciplinary project working, bringing together students from complementary disciplines, preparing them to work in cross-disciplinary teams.

3.4.3 Direction of Policy

The direction of policy favours developing generic skills, which is positive for creativity and innovation. However, broader thinking on developing creativity and innovation at policy level seems less well developed than in the school system or in higher education. While there are many examples of good practice in the sector, there is a need to capture and diffuse these more broadly.

3.4.4 Conclusions

Most courses in the sector are taught in small groups, which ensure that they have a sufficient quantity of teaching resources to teach in ways that promote creativity and develop innovative capability. However, in many cases there are obstacles.

- In many areas, the need to teach courses in this way has not been clearly identified by teaching staff or the organisations for which they work.
- While FETAC has improved matters significantly by requiring that courses include generic skills modules, there is a need to go further by specifying that these should be taught in a way that links tightly to the main subject matter of the course, and that teaching methods for at least some other modules on each course should be designed to promote creativity and innovative capability.
- As with any change in teaching methods, there is a teaching skills issue. There will be a need to diffuse good practice to teaching staff through training and other methods.

3.5 Taught Higher Education

3.5.1 Introduction

This section addresses both:

- Undergraduate "third level" education (primarily Higher Bachelors Degrees, Ordinary Bachelors Degrees and Higher Certificates); and
- Those parts of postgraduate "fourth level" education (primarily taught masters degrees and postgraduate diplomas) that are taught in format.

The section that follows addresses postgraduate "fourth level" education pursued through research (primarily research masters degrees and PhDs).

3.5.2 Best Practice

Higher Education Courses Generally

A number of key points come out of interviews and the literature on good practice in preparing students in higher education to be innovative.

- It is best if the main measures taken to build skills in creativity and innovation are built into the process of learning about the core material in the subjects that students are studying.
- Pure "chalk and talk" approaches to teaching are not effective in developing creativity and capability to be innovative. Teaching and assessment methods that engage students, making them practice skills relevant to creativity and innovation, are required. Most of these methods require small group teaching, although small group teaching of itself gives no guarantee that they will be used.
- There can be a place for separate courses in areas such as communications or creativity, but colleges should not rely on such courses alone to develop skills in these areas. If they do use courses such as these, it is usually necessary to adapt them to the specific subject interests of the students taking them in order to maximise learning and engage their attention.
- A specific course in creativity is most likely to add value in a discipline that already has a heavy creative focus embedded within it, as in for example a course in entrepreneurship, and where the course in creativity is designed to introduce and apply specific tools for creativity that build on other creativity-developing approaches.
- There is no single universal set of approaches that works under all circumstances. Practices that often work well include the following.
    - Project work is useful in itself, in that it promotes independent learning, but also because it can form the foundation for other useful practices. Depending on the design of the project assignment, it can promote creativity and even innovation to a greater or lesser extent.
    - Team-based projects give students excellent practice at teamworking.
    - Where project assessment includes presentations, this can give excellent practice at this aspect of communications. Writing up projects also gives useful practice in written communications.
    - The best way in which higher education institutions can develop horizontal **T**-shaped skills among their students is though cross-disciplinary projects. These bring students from complementary disciplines together to work on projects, and form an excellent way to develop understanding and empathy for people specialised in other disciplines, and to prepare them to work with people from those disciplines after graduation. They also establish contacts across disciplines that widen students' personal networks, giving them access to complementary skills and knowledge that will make them more likely to innovate after graduation.

- Several successful Irish and international examples were identified in the course of the study. Many interviewees identified this sort of project work as representing one of the best available opportunities to boost the innovative capability of Irish students. However, many also observed that the level of co-ordination between different academic departments, schools and faculties required to make it work can be difficult to achieve.
- The case study method, which is used particularly in some business disciplines, gives students the opportunity to solve problems, practice using analytic tools and identify creative solutions. Ideally, it is used in classes that are small enough (no more than around 50) to allow for a meaningful analysis and discussion of the case, which contributes to developing analytic, communication and advocacy skills. Often case study assignments are given to teams, which develops teamworking.
- There is a major movement internationally advocating the use of "problem-based learning" (PBL) and inquiry-based learning (IBL) approaches to teaching in higher education. These are student-centred instructional strategies in which students solve problems collaboratively, and reflect on their experiences. Typically, students are divided into groups to address problems. Teaching in problem based learning normally occurs within small discussion groups of students facilitated by a tutor. There are various advantages that do not directly impinge on creativity and innovation, in terms of energising students and faculty, ensuring that students internalise the subject matter of the course, reducing risks of non-completion, and catering for students who may not thrive in a traditional lecture setting. It is often argued that there are also costs in terms of a greater requirement for faculty input (although it is sometimes disputed that this continues once PBL is established). Problem-based learning is not an all-or-nothing strategy. It is possible to implement it to varying degrees within a subject, and it is possible for PBL-based subjects to co-exist with more conventionally taught subjects within a higher education course.
- PBL and IBL are of interest here because they develop key underpinning skills required for creativity, in areas including teamworking and problem solving, and more generally because they are seen in much of the literature as developing skills in creativity[28].
- In the US and in many other countries internationally, it is usual for undergraduate students to have significant freedom to take courses outside their major. This is useful in allowing students to develop a breadth of perspective, which can stimulate creativity. It can contribute to horizontal **T**-shaped skills, particularly where students choose to study material in a complementary discipline such as, for example, an engineering student taking courses in entrepreneurship or design, or a humanities student taking courses in information technology, science or engineering.
- Work placements are seen as having a useful role to play in developing creativity and preparing students to be innovative, in that they ground students in the reality of the working environment, and provide a useful context for the remainder of their studies. They also frequently provide useful project working, problem solving and teamworking experience.

28 See, for example, p.3 Understanding Enquiry-based Learning (EBL), Peter Kahn and Karen O'Rourke, Chapter 1 of Handbook of Enquiry and Problem-based Learning - Irish Case Studies and International Perspectives, editors Terry Barrett, Iain Mac Labhrainn and Helen Fallon, Centre for Excellence in Learning and Teaching, NUI Galway and All Ireland Society for Higher Education (AISHE), Dublin.

- While an understanding of other disciplines is useful, it is important that this should not obstruct students from achieving sufficient depth in their main discipline. For this reason, approaches that allow students to learn more about other disciplines while at the same time working in their own (such as cross-disciplinary project work), may be more effective than approaches that take students away from their main discipline for significant periods.
- At a more structural level, semesterisation and modularisation are seen as playing an important role in enabling practices that develop creativity among students.
    - They facilitate colleges in allowing students flexibility to take some subjects outside their core discipline.
    - They facilitate co-operation across departments and faculties. With all courses structured and timed similarly, it becomes easier for two or more departments to co-operate, whether in terms of sharing staff or sharing students.
    - By moving away from an assessment model focused on end-of-year examinations, semesterisation and modularisation can facilitate the adoption of new approaches to assessment, that better measure creativity.
- In general, approaches to learning that develop creativity well are difficult to implement effectively without low staff-student ratios, as they require a fair degree of involvement between staff and students. Project work, problem based learning and the effective use of case studies are all difficult to reconcile with heavy use of large-theatre lectures.

Higher Education Courses in Design and Other Creative Disciplines

The approaches to developing creativity and innovation in other areas of higher education are broadly applicable in design and other creative disciplines too. These disciplines have a strong tradition of being practically-based, and indeed traditional ways of organising courses have much in common with problem-based learning.

Areas of good practice seen that are a little outside the traditional mainstream include the following.

- Within design, and particularly product design, courses should ideally go beyond focusing on technical skills, the design language and creativity to also focus on skills that will allow the designer to be an effective member of an innovating team. Key topics include (see Figure 2.4): understanding how to take a user-centred approach to design; understanding the market; **T**-shaped skills to work with other disciplines; and leadership skills. The other disciplines that designers will have to work with vary depending on the discipline.
- There is a general need for graduates in creative disciplines to have business skills and knowledge in addition to the core skills of their discipline. As seen earlier, those graduates in creative disciplines who do not go into teaching mostly work close to market, either within a business or running their own one person business. While the inputs that most courses have from practitioners make a useful contribution to this, there is also a need for some formal content in the area.

3.5.3 Irish Practice

Higher Education Courses Generally

It is clear from the interviews undertaken for this study that there is a great degree of variation in the extent to which Irish higher education taught courses promote creativity, and prepare students to be innovative. Leaving aside creative disciplines, the interviews undertaken showed no strong pattern of institutions or disciplines being uniformly strong or weak on student creativity and preparation for innovation.

Instead, they showed that performance in this area depends heavily on choices made by those responsible for designing and providing courses.

Choices about resourcing form a part of the picture – while a course with a high teaching input per student may perform well, average or poorly on instilling creativity, it is difficult for a course with a low input to engage with students sufficiently actively to perform well. Tight resourcing constraints make it difficult for colleges to provide as much teaching input as they would like, and the choices they make about allocating the available time of academic staff, and about supplementing this with tutors and part time lecturers, have a major influence on their performance of courses in promoting creativity and capability to innovate.

Some interviewees, seeing an increasing prevalence of large class sizes, expressed concerns that the stage at which students learn to think and learn independently and creatively has moved in some areas from undergraduate level to taught postgraduate level, and is possibly now moving from there to research degree level.

Even so, interviews with academics highlighted cases in institutions in both the university and Institute of Technology sectors where those responsible for courses have been creative themselves in organising, structuring and delivering courses in ways that promote creativity and innovative capability among students.

Areas where they have achieved this include, for example:

- Splitting large undergraduate business classes into multiple small classes in which it is possible to have meaningful discussions about case studies or other material;
- Offering more regular project work;
- Offering projects that pose relatively unstructured questions;
- Offering projects that address a genuine industry requirement, in which it is possible for students to engage with a business in innovation;
- Arranging cross-disciplinary projects, with students from complementary disciplines spanning different broad disciplinary groups, such as business and engineering, either as a core part of course work, or as entries into student competitions;
- Implementing problem-based learning approaches; and

- Designing projects so as to encourage the development of teamworking and communications skills, for example with presentations forming a major part of the assessment approach.

Some of Ireland's larger universities have introduced undergraduate programmes allowing students to pursue multiple disciplines of study while working towards one overall award.

Employer interviews confirm that there is considerable variation in the extent to which graduates are prepared to be creative, and in the extent to which they have developed the skills required to contribute effectively to innovation.

Higher Education Courses in Design and Other Creative Disciplines

Higher education courses in design and other creative disciplines attract students with a high degree of creativity, and the process of assessing portfolios generally guarantees that those who are admitted are creative. School leavers have access to portfolio preparation courses in the further education sector (generally one academic year in duration), so those whose creativity may have been held back in second level have a means to develop it further before applying for a course in design or art.

There was a sense from interviews undertaken with schools of art and design that there is resistance in some areas to changes that involve cross-disciplinary co-operation, whether within the school, or with other schools within the same institution or nearby institutions, and that this has slowed the adoption of cross-disciplinary learning initiatives. There is also a sense that some colleges have not given much consideration to the possibility of including relevant business related content, or content focused on the sort of analysis of user needs, market understanding, **T**-shaped skills and leadership skills that might improve the preparedness of designers to work in teams focused on product and service innovation.

3.5.4 Direction of Policy

Irish public policy has developed in ways that are generally friendly towards reforms that will promote creativity and capability to be innovative among students.

According to the Call for Proposals for Cycle II of the Higher Education Authority's Strategic Innovation Fund (SIF):

SIF will be used to enhance the capacity of individual institutions and the sector collectively to deliver on the fundamental mission of teaching (within the context of the National Qualifications Framework), research and societal needs. Specifically, it is envisaged that the SIF will be used to improve the educational learning experience for students so as to better allow them to achieve their full potential. SIF may also be directed towards improvements for students participating in both taught and research oriented programmes.

The objectives of the SIF include - the enhancement of the delivery of core activities of education and research, through effective and creative institutional and inter-institutional collaboration and, where necessary, appropriate internal restructuring and rationalisation efforts; to support innovation and quality improvement in teaching and learning, including enhanced teaching methods, programme restructuring, modularisation and e-learning; to support access, retention and progression at institutional level and through inter-institutional and inter-sectoral collaboration.

If there is a future round of the SIF, initiatives to promote creativity and capability to be innovative among students fit clearly within its scope, and the likelihood is that many of the initiatives supported under the fund would be supportive of this. However, there is no explicit requirement that this sort of improvement would take priority over other improvements in the educational experience.

There have been a number of major developments in assuring the quality of Irish higher education qualifications in recent years, including the establishment of the National Framework of Qualifications (NFQ) and the establishment of the Irish Universities Quality Board (IUQB) and the Higher Education and Training Awards Council (HETAC). These developments provide mechanisms to guide higher education institutions towards the adopting of practices that will enhance the quality of their work. There are currently plans to merge HETAC with the National Qualifications Authority of Ireland (NQAI) and the Further Education and Training Awards Council.

The National Framework of Qualifications identifies creativity as one of the main contextual competences to be associated with higher education qualifications. HETAC's Award Standards describe higher education awards under three broad headings:

- Knowledge – Breadth and Kind;
- Know-how and skill – Range; and Selectivity; and
- Competence – Context; Role; Learning to learn; and Insight

The standard for each undergraduate level higher education qualification refers to creativity as a central contextual competence.

Figure 3.1 HETAC Level Indicators for Competence - *Context*

Level	**Level Indicators for Competence -** *Context*
Level 6	Act in a range of varied and specific contexts involving creative and non-routine activities; transfer and apply theoretical concepts and/or technical or **creative** skills to a range of contexts
Level 7	Utilise diagnostic and **creative** skills in a range of functions in a wide variety of contexts
Level 8	Use advanced skills to conduct research, or advanced technical or professional activity, accepting accountability for all related decision making; transfer and apply diagnostic and **creative** skills in a range of contexts
Level 9	Act in a wide and often unpredictable variety of professional levels and ill-defined contexts

The Higher Education Authority and the Irish Research Council for the Humanities and Social Sciences are currently undertaking a Foresight exercise on the Arts, Humanities and Social Sciences, looking at the contributions the Arts, Humanities and Social Sciences make to the economy and society, the current strengths and weaknesses and the possible contribution that these disciplines may make in the future. This is likely to raise the policy profile of Design, Art and other creative disciplines.

3.5.5 Conclusions

The uneven extent to which taught courses in the Irish higher education system develop creativity and capability to innovate among students on taught courses means that there is considerable room for improvement. Examples of good practice visible within the system demonstrate that addressing this is not purely a matter of resourcing, although the availability of teaching resources is one of the constraints limiting progress in the area.

Aside from the force of persuasion and good example, there are two existing sources of leverage that could perhaps be used to promote good practice in developing creativity and capability to innovate among students, given a relative minor recalibration of their focus.

- Future cycles of the Higher Education Authority's Strategic Innovation Fund and Programme for Research in Third Level Institutions could more explicitly ask for proposals that address this need;
- Quality assurance processes in the higher education sector could place a higher system-wide priority on creativity, which is already recognised appropriately within the National Framework of Qualifications.

Key practices that should be promoted include:

- Widespread use of cross-disciplinary project work, bringing together students from significantly different, but complementary, disciplines;
- More project work in general; and
- Increased use of problem-based learning and inquiry-based learning approaches.

There is a need for a degree of balance in how this is approached. Any attempt to force all participants on all courses into a single good practice model will cause problems. On the other hand, there is a general need to push academics and students who are comfortable in a single-discipline environment into broadening their horizons to engage with disciplines very different to their own, even if this means some discomfort. It is up to higher education institutions, funding bodies and quality assurance agencies to find the right way to strike this balance.

The planned amalgamation of the three quality assurance agencies in education[29], along with the Higher Education Authority's quality assurance function, may provide an opportunity to implement

29 National Qualifications Authority of Ireland (NQAI), Higher Education and Training Awards Council (HETAC) and Further Education and Training Awards Council (FETAC)

the increased quality assurance emphasis on creativity. In the interim, these agencies should work together to enhance the emphasis on creativity in their work on quality assurance.

Example of Change to Pedagogical Approach that has Made an Impact in Higher Education

In business education, there is a tension between an economic impetus to deliver classes to large groups, and the difficulty in engaging students in discussions and case studies in such large groups. While the core material can be imparted to a large class, learning to apply it creatively is difficult to achieve outside a small group context. When the new Quinn School of Business building for undergraduate business students at UCD was being planned, the Faculty of Commerce decided to move away from large group teaching, to teaching undergraduate classes in relatively small groups, so as to enhance the quality of education. The building was planned to take classes of 50 students, with 11 first year classes operating in parallel for each core subject in the BComm degree course. For each subject, classes are developed and overseen by a lead academic, and mostly delivered by part time lecturers with a practical background in business.

According to the School:

"Teamwork is promoted among students through group projects and assignments and our small classes offer you the ideal platform for learning other key business skills such as presentation and organisational skills.

"Rather than having a straightforward lecture, class participation encourages learning and improves your communication skills. Simulate real-life business scenarios, make presentations, conduct research, analyse theories, test your decision-making abilities and then observe the consequences of your decisions."

Feedback from employers is positive, seeing graduates from the School as being creative and capable of contributing to innovation. The changes appear to have contributed to the rise in UCD's standing among world universities, to being ranked 62nd in the world by employers in 2008. (Times/QS Top Universities)

3.6 Higher Education by Research

3.6.1 Introduction

This section addresses postgraduate "fourth level" education pursued through research (primarily research masters degrees and PhDs). The Strategy for Science, Technology and Innovation (SSTI) is the framework within which efforts are being made to increase PhD output.

3.6.2 Best Practice

Research in the Irish higher education system has developed rapidly in recent years, supported by very substantial growth in State funding. As a part of this process, the number of students studying for PhDs on funded projects has grown rapidly. Higher education institutions and funding agencies have developed a strong interest in best international practices for PhD education, and are progressively implementing improvements based on what they find.

The key change that they have identified, that is relevant to skills for creativity, is a need for students to go through a programme of professional development, alongside their research work. This programme of professional development should include training in transferable skills that will assist PhD graduates in transferring into regular employment. While the transferable skills training available would vary between institutions and disciplines, it would generally at least build generic skills and industry knowledge among PhD students, and would therefore improve their broader capability to engage in creativity and innovation, while acquiring a deep knowledge of the subject matter of their research.

An additional theme has emerged from the research undertaken for this study, both from interviews and paper research, which relates to the increasing importance of multi-disciplinary studies in PhD programmes, whether in the core research, or in coursework.

Stanford University is one of the leaders in this, with large numbers of interdisciplinary research programmes, with opportunities for PhD students to undertake large parts of their coursework outside the school in which they are enrolled, with a programme of fellowships for interdisciplinary graduate study, and with the Stanford Graduate Summer Institute offering free non-credit bearing interdisciplinary courses to Stanford graduate students, taught in a workshop format.

The Expert Group on Future Skills Needs has previously referenced one of the many interdisciplinary initiatives at Stanford, in the report on the Skills Needs of the Medical Devices Sector, which has a particular resonance for the theme of creativity, design and innovation. One of the key elements of the Stanford Biodesign Programme is the Biodesign Innovation Fellowship, under which, each year, two interdisciplinary teams of fellows from clinical, engineering and business backgrounds, take on the challenge of identifying opportunities for an innovative medical device, choosing from among them on the basis of business potential, and bringing the device at least as far as the prototype stage. While the main purpose is educational, a number of the projects have been turned into businesses. Of particular interest to the current study is that the Fellowship programme is mirrored at a less intense level in an interdisciplinary graduate student course, which is tutored by the fellows. On this course, interdisciplinary teams of graduate students from engineering, business and medicine take on the most promising project ideas rejected by the fellows, and go through a similar process of market analysis and product design and development.

As in taught courses, while an understanding of other disciplines is useful, it is important that this should not obstruct students from achieving sufficient depth in their main discipline. For this reason, approaches that allow students to learn more about other disciplines while at the same time working in their own (such as cross-disciplinary project work), may be more effective than approaches that take students away from their main discipline for significant periods.

3.6.3 Irish Practice

Higher Education Research Programmes

The Irish Government has ramped up investment in higher education research very considerably in recent years, through Science Foundation Ireland, the Higher Education Authority (primarily the Programme for Research in Third Level Institutions), Enterprise Ireland, the Irish Research Council for Science, Engineering and Technology, the Irish Research Council for the Humanities and Social Sciences and the Health Research Board. In addition, the Technological Sector Research Fund promotes the development of capacity for R&D in the Institutes of Technology.

All of this research activity is driving a steep increase in the output of graduates with research degrees. The principal use for research degree graduates in industry is as professional innovators.

The Irish Universities Association has published a statement of the desired learning outcomes and skills that PhD students may develop during their studies, which students develop through their research and additional taught modules[30].

Professional Education

The Irish higher education system has responded to the identified need for professional development for research students, with higher education institutions introducing courses and modules for their students in transferable skills and other topics. According to the Irish Universities Association, the intention is "to offer a rounded PhD education and research training programme to all students".

Institutions have been supported in this under the Higher Education Authority's Strategic Innovation Fund and Programme for Research in Third Level Institutions, under the Graduate Research Education Programme (operated by IRCSET and IRCHSS under the auspices of the Minister for Education and Science), and more generally by research funding bodies funding students to undertake professional development as well as research.

This is very positive from the creativity, design and innovation perspective, as it develops generic skills, as well as other skills that may contribute to creativity. It has also created space in which further innovation in PhD education can occur. It contributes to developing horizontal **T**-shaped skills.

Interdisciplinary Skills and Commercialisation of Research

Ireland has ramped up investment in research in recent years. The main purpose in this has been to boost the innovative capability of the economy. The increased investment can potentially benefit the economy in a number of ways.

1 Much of the research generates intellectual property that can obtain a return simply through licensing.

30 Irish Universities' Graduates' Skills, IUA, 2008

2 Research generating intellectual property can be commercialised with the involvement of the researchers through establishing new entrepreneurial ventures, licensing the colleges' interest in the intellectual property.

3 There may be some spin-off of capabilities developed through research to existing indigenous Irish companies, and to multinationals already present in the country, through contacts and cooperation between higher education research and industry.

4 The research generates a supply of PhD graduates, who can be employed in research, either in existing businesses, or by attracting new research operations to Ireland.

5 PhD graduates who enter areas of employment other than research may potentially perform more creatively and innovatively than recruits with lower levels of qualification.

All but the first of these imply a role for PhD graduates as **professional innovators**, and that PhD programmes should prepare them to work in this sort of role. Based on the interview evidence, it is apparent that this reality should be made more explicit, both at a science and technology policy level, and within higher education research programmes. It is unlikely that higher education institutions will ever recover more than a small fraction of State expenditure on research directly through higher education technology transfer licensing[31]. If investment in research is to generate a positive return, this will largely be through the involvement of PhD graduates and academics in bringing innovative products and services to market, in improving company processes, and in preparing future generations of students to be creative and to innovate.

The first of the points above has been addressed in a reasonable way by the establishment of technology transfer offices in the higher education sector, which are working at exploiting intellectual property through licensing, in much the same way that similar offices do in US universities. It should be borne in mind that most US universities only recover a small part of the investment in research that they undertake through licensing. The likelihood is that licensing income will only make a small contribution to recovering the Ireland's publicly funded investment in research, so it will be important to make the most of the other ways in which research can benefit the economy.

The third, fourth and fifth points are currently under consideration by an Advisory Science Council (ASC) Task Force on Optimising the Fourth Level Contribution to Enterprise in Ireland.

The second emerged from interviews undertaken for this study as being a considerable challenge in which skills in creativity and innovation have an important role to play. One of the great enterprise policy attractions of higher education research is its tendency to spin off high value ventures, resulting in the growth of substantial clusters of innovative ventures in the areas surrounding major research universities, whose roots either lie directly in university research or in businesses that were originally founded on it. This has worked in places such as Massachusetts (with MIT), Silicon Valley

31 In 2006, only six US universities earned as much as 10 percent of what they spent on research in intellectual property licensing fees. Stanford earned 8.7 percent. The University of Minnesota earned 9.4 percent. The University of California System earned 6.4 percent Source: Forbes

(with Stanford), the area surrounding Cambridge in the UK, and to a lesser, but substantial, extent around other research universities.

The effect exists in Ireland, but it is weak relative to the volume of research undertaken[32]. If it could be boosted successfully to levels that are usual in the US, this would have a major positive economic impact.

It is not the place of this report to analyse all the obstacles to spinning new businesses out of higher education research in Ireland. Observations were made in the course of interviews for the study about, for example, the availability of venture funding at various stages of company development, and the priorities of technology transfer offices, which it is not the place of this study to evaluate. However, an issue that came through strongly is that serious deficiencies in business skills form a major part of the picture and that there is little prospect of a major rise in successful spin-out activity from higher education research unless those deficiencies are tackled. Indeed, to the extent that other issues exist, some of them could be rational responses to the business implications of these skill deficiencies, which might ease if the deficiencies were tackled.

The key issue with business skills lies in a disconnect between skills in science, engineering and technology (SET) on the one hand, and business disciplines on the other. While this is not wholly a matter for the higher education system, and businesses have an important role to play in developing cross-disciplinary skills among their employees, segregation between business and SET disciplines in the higher education system undermines prospects for higher education research to drive innovation.

Students undertaking PhD research in SET disciplines are not learning much about business, and more importantly are not learning horizontal **T**-shaped skills in how to work with people who have a business perspective. Students studying business at graduate level (mainly in the form of taught MBA and MBS courses, rather than research degrees) are not learning to work with people specialising in technology disciplines. Relatively few students study to PhD level in business disciplines.

The need for skills in these areas is recognised in the Irish University Association's statement on PhD skills, which identifies the following as being important under the heading of entrepreneurship and innovation:

- Understand the role of innovation and creativity in research;
- Demonstrate an awareness and understanding of intellectual property issues, appreciate and, where appropriate, contribute to knowledge exchange;
- Appreciate the skills required for the development of entrepreneurial enterprises in the public and private sectors; and
- Understand different cultural environments, including the business world, and the contribution that knowledge transfer can make to society.

32 In software, where there has been a major upwelling of innovation since the early 1990s, only a small minority of ventures are founded on higher education research. The Irish software sector is primarily an applications sector, innovating more on the basis of insight into the industries in which its products are used, than on substantially new technology.

The current disconnect within higher education has a number of negative effects:

- It makes it unlikely that most PhD research students in SET disciplines will aspire to commercialising their research, or finding other research to commercialise if their own turns out to be poorly suited to commercialisation, or is more suited to licensing.
- It means that PhD graduates lack the horizontal **T**-shaped skills that they would need to work effectively with people from a business background to maximise the commercial success of a business founded to commercialise a technology.
- In means that masters level business graduates, who should ideally be good candidates to take on lead commercial roles in technology start-ups lack the horizontal **T**-shaped skills that they need to work with people from a technology background. It means that PhD level business graduates who might ideally be even better candidates largely do not exist, and, where they do, also mainly lack the required horizontal skills. The pattern whereby some engineers and technologists to study for an MBA or Masters of Technology Management offsets this to only a limited extent.

When this issue was discussed in interviews undertaken for the study, a strong view came through that it could be addressed effectively by bringing research students and postgraduate business students together in interdisciplinary studies – with the greatest opportunity being in **joint projects involving both PhD researchers in SET disciplines and postgraduate business students** that could be undertaken as joint coursework (as in the example from Stanford quoted above).

Other possible measures to better connect PhD studies to business include:

- Industry placements for PhD researchers (the IUA's 4th Level Ireland initiative refers to "strong links to external stakeholders, with opportunities for placements in relevant economic sectors); and
- Greater use of part time PhD study by people in employment, which has been eclipsed by the growth of full time funded PhD research in recent years, and which is a major feature of higher education research in many other countries (for example under Stanford's Honours Co-operative Programme).

The development of professional education components within PhD research programmes has created space within which cross-disciplinary and industry-related initiatives can take place without taking away from the disciplinary depth of the PhD.

There is of course also a need for businesses to promote cross-disciplinary contacts and learning among their employees. This is addressed later.

Research in Business Disciplines and Creative Disciplines

Alongside the major increase in research that has taken place within science, engineering and technology disciplines, there has also been a dramatic, if much more limited, increase in Irish higher education research activity in the humanities and social sciences. This is very positive from the perspective of skills in creativity and innovation, as it is greatly increasing the number of people in

the economy with deep skills and knowledge in a diverse range of areas. Some of these have clear potential for economic application; in other cases, the potential may not be obvious, but the increased diversity of perspectives they bring to the country should be positive for creativity in any case.

However, research is relatively undeveloped in two key areas that are relevant to innovation.

- Relative to the number of academics and students in business disciplines, there is not much research activity in Ireland focused on business and management practice. As a consequence, Irish management research has limited impact on teaching in Irish institutions, and little impact on Irish management practice. As a country, we are largely reliant on research done in other national contexts for what is taught in our business schools.
- We should be looking to Irish management research to complement what is available internationally, in order to help businesses boost their innovation capabilities. This is unlikely to happen without a much greater emphasis on research into management practice than exists at present.
- Higher education research activity in art and design is also underdeveloped, although it has increased somewhat from the very low levels of the past, with some interdisciplinary and inter-institutional research work now underway. Again, we should be looking to research in this area to contribute to innovative capabilities.

3.6.4 Direction of Policy

Higher education research plays an increasingly important role in Irish industrial policy, and is one of the principal ways in which Ireland is investing in moving to higher value added activities. This is reflected in the substantial funding now being channelled to research in the higher education sector through Science Foundation Ireland, the Higher Education Authority (principally through the Programme for Research in Third Level Institutions), Enterprise Ireland and the Health Research Board.

The main industrial policy benefits that are anticipated are that:

- The supply of research graduates can be used to attract inward investment in research activities, either independently of higher education institutions or in cooperation with them;
- The capabilities developed through research will spin off to existing indigenous Irish companies, and to multinationals already present in the country, through contacts and cooperation between higher education research and industry;
- Some research will generate innovative spin-off businesses, and, as has happened in major centres of innovation in the US and elsewhere, these and their descendents will eventually become a major feature of the Irish economy;
- Colleges can obtain an income through licensing the intellectual property created through research, giving them an incentive to focus on economically relevant aspects to research; and
- PhD graduates who enter areas of employment other than research may potentially perform more creatively and innovatively than recruits with lower levels of qualification.

3.6.5 Conclusions

The initiatives taken by the higher education system to add professional development courses, modules and subject-based modules to PhD research programmes are very positive from a creativity and innovation perspective, reinforcing the **T**-shaped skills concept for the structured PhD. The IRCSET Enterprise Partnership Scheme, funded in collaboration with an industry partner and involving collaboration with the industry partner, is another useful development.

There is a need to go further, to tackle a disconnect that exists between science, engineering and technology (SET) disciplines on the one hand, and business on the other, in order to develop the mutual empathy and understanding between business graduates and research SET graduates that is required if Irish research is to become more successful at spinning out start-up businesses. One very promising measure that could be taken would be to develop a system of joint coursework projects for PhD researchers and postgraduate business students. Other possible developments include use of industry placements for PhD researchers, and greater use of part time PhD study by people in employment.

As in taught programmes, there is a need for balance in how this is approached. Any attempt to force all research students into a single good practice model will cause problems. On the other hand, there is a general need to encourage academics and research students who are comfortable in a single-discipline, non-commercial environment to broaden their horizons, even if this means some discomfort. It is up to higher education institutions, funding bodies and quality assurance agencies to find the right way to strike this balance.

There is a need to boost research activity in management practice and in art and design, to develop capabilities to underpin increased innovation in Irish industry

The last ten years has seen a rapid development of the Irish Research landscape and while support for Creative Arts research has not been a significant feature of this growth there are now significant signs of enhanced and important activity. The Graduate School of Creative Arts and Media (GradCAM) supported by the Programme for Research in Third-Level Institutions (PRTLI) is one such example. This collaborative initiative builds on the expertise of the Dublin Institute of Technology, the National College of Art & Design, the University of Ulster, and the Institute of Art, Design and Technology, Dún Laoghaire. The School has been established as a centre for creative research development which will facilitate, promote and will lead interaction between cultural practice, educational practice and the everyday world of work and innovation in the arts. The issue of funding for creative arts research is being raised currently through a number of avenues, particularly the Foresight in the Arts, Humanities and Social Sciences Exercise. It is understood that a number of institutions and organisations have raised this issue in submissions to the Foresight Exercise.

3.7 Developing Workplace Skills in Creativity, Innovation & Design

3.7.1 Best Practice

There is a considerable amount that can be done to develop the workplace skills of those in employment, and out of full time education. However, development of skills in creativity, design and innovation is effective only insofar as it complements a broader innovation strategy for the business.

There must be a clear place for innovation in the business's strategy. There should be clarity as to:

- The business objectives for innovation;
- Who has permission to innovate, and under what circumstances;
- How innovation is to be resourced;
- How innovation is to be rewarded; and
- How the risks associated with innovation, to the business and to employees involved, are to be managed.

Creativity and innovation also require effective business leadership.

In many cases, formal programmes and projects can play important roles in fostering and enabling creativity and innovation. These can range from programmes to develop new products or services to programmes to incrementally improve business processes or customer relationships. Examples include a new product development initiative; a benchmarking initiative; a customer or user research initiative or a Six Sigma and/or Lean Manufacturing initiative.

Less formal approaches can also play a role, integrated more tightly with day-to-day work, or responding opportunistically to opportunities for innovation that appear.

Some leading innovative global businesses allow staff to devote a portion of their working time to working on innovative projects of their own choice.

What is required in skills terms depends on the occupation, the industry and the specific needs of the business.

- Business strategy is fundamentally a creative exercise, and skills in the area are generally important to senior and middle managers. While training in the area can be seen as falling into many other areas of enterprise policy too, it is a form of training in creativity and innovation.
- Skills in management of innovation, design and creativity constrain how effective a business will be in innovating. A closely related area of skill relates to developing and maintaining a creative and innovative culture in an organisation. Training in these areas for managers, and senior *professional* and *sporadic innovators* can make a valuable contribution to a business's innovative potential.
- Success in product and service innovation can have a transformational impact on a business, but many *professional* and *sporadic innovators* have little or no education or training in the topic.

There is a widespread need for engineers, scientists, marketers and managers to receive training in the area.

- While most of those working in *creative* occupations have a good base of creative skills, technological change can frequently drive a need to update those skills. Moreover, in many cases there is a need for *creatives* to move up the professional ladder into roles requiring a stronger understanding of user perspectives, a better understanding of the market, greater ability to work with people from complementary disciplines (horizontal **T**-shaped skills) and leadership skills.
- Skills relating to process improvement are important to many *sporadic innovators* (e.g. operations managers involved in "lean" initiatives) and *professional innovators* (e.g. software process improvement) and are central to the contribution of *creative problem solvers* and *innovators through work organisation* to innovation in an organisation.
- Skills in launching products are required, to complete the commercialisation process, turning an invention into an innovation, and training for managers, marketers and sales people can contribute.
- For some businesses, particularly those in industries with Standardised Outputs and Many Innovation-Focused Jobs, a range of issues around intellectual property (IP) can be important, including managing the organisation's own IP, sourcing IP or technologies from outside the business to as part of the innovative process, and indeed managing IP risk.
- For an increasing number of businesses, regulatory matters constrain and shape the ways in which they can innovate. Training in regulatory affairs can be required by these businesses.

More generally, just as there is a need for students to be exposed to disciplines complementary to their own, there is also a need for companies to break down "functional silos" that limit contact between people from different functions in an organisation, and to themselves develop the horizontal T-shaped skills that are required for people with complementary skills and expertise to cooperate.

Apart from these specific areas of education and training that relate directly to skills in creativity, design and innovation, the skills agenda for businesses concerned with innovation includes a more general need to upgrade the qualifications and skills of their staff. As the Expert Group's report "*Tomorrow's Skills: Towards a National Skills Strategy*" (2007) has already covered this topic in detail in the recent past, it is not covered again here. However, it can be taken that the recommendations of this report on the One-Step-Up Approach and continuous learning are directly relevant to the agenda of developing skills in creativity, design and innovation.

The ways in which education and training are delivered to people in employment tend to vary between countries depending on national institutional frameworks. It is not possible to identify a single international best practice in this area.

3.7.2 Irish Practice

Existing Irish practice is that a number of organisations, and types of organisation, are involved in delivering education and training relevant to creativity, design and innovation to those in employment. Between them, there is at least some degree of involvement in provision for each of the types of education and training listed above.

- Enterprise Ireland offers a range of company development supports that can be combined into a company specific support package. They can include any of the types of education and training listed above, as well as others that are less directly concerned with creativity, design and innovation, and supports that are not related to skills. In its supports, Enterprise Ireland now places a heavy emphasis on design, in addition to its more traditional emphasis on technology and markets.
- During 2008, Enterprise Ireland announced a programme of *Enterprise Innovation Networks* to focus on a research or technology theme that is of direct relevance to their members, with four networks to be launched initially. The industry representative group behind each network will be expected to develop new initiatives to promote R&D and innovation activity under that theme to their membership.
- The *Workplace Innovation Fund*, which Enterprise Ireland operates jointly with the National Centre for Partnership and Performance, is particularly relevant to developing skills for process change.
- Skillnets funds industry led training networks, some of which operate in the creativity, design and innovation space. Networks compete for funding, based on the strength of their proposals. Skillnets funds a network manager and an agreed share of the cost of training provided by each network. In a workshop conducted with interested networks for this study, participating networks described training initiatives covering the first five of the above areas (listed under Best Practice), with most networks involved in two or more of the areas.
- In many cases, a Skillnets network provides a mechanism through which an existing business or professional organisation, or indeed a trade union, can provide a programme of training activities. Examples of each of these types of organisation are active in operating networks with a focus on creativity, design and innovation, as well as independently formed networks.
- The *Competency Development Programme* is the primary FÁS intervention targeted on developing skills among those in employment. The CDP is focused on the needs of employees in priority skill areas. Programmes are developed and made available, targeted at national, sectoral and regional labour market needs. Delivery of training can come from a variety of organisations including FÁS, VECs, private companies, employer networks and large companies. There is a wide variety of training programmes available under the CDP. A few, such as those in Lean Manufacturing, have a specific focus on innovation. More are concerned with teaching computer skills, which form a relevant part of generic skills. Some cover skills that require a degree of creativity or design capability, such as *Winning Tenders* or a course in *3D AutoCAD*. Some are substantial certificated programmes that are required to have generic skills modules. On the other hand, some have very limited connection to creativity, innovation and design.
- Overall, there appears to be scope to boost the focus of the Competency Development Programme on creativity, design and innovation.

- The FÁS Workplace Basic Education Fund provides a 100 percent training subsidy to enhance employees' basic skills needs to enable them to cope with frequent and ongoing changes in work practices. FÁS also recently launched the *Training of Workers with Lower Levels of Qualification* initiative. Programmes such as these play an important role in building the generic skills that people with low levels of qualification need to participate effectively in innovation.
- FÁS has also recently launched an *SME Management Development* initiative. Addressing the skills of SME managers is centrally important to innovation because of the large share of employment that SMEs account for, and because there are widespread deficiencies in their skills. It will be important that this initiative should address topics such as business strategy, innovation management and workplace innovation that are important to the practice of creativity and innovation in SMEs. Some content on design thinking could also be of value.
- The Higher Education Authority's Modular Accreditation Programme allows those in employment to choose modules from any or all of the collaborating higher education institutions involved, potentially leading to the award of a higher education qualification at levels 6-8 (e.g. Honours Bachelor Degree) or Level 9 (e.g. Masters Degree). It includes modules in management skills, including finance interpersonal skills, leadership and logistics in its offering. It uses the ECTS credit system to track progress towards an award. It has the potential to embrace cross-disciplinary awards, as well as flexible modes of learning.
- FÁS operates *Screen Training Ireland*, a programme which provides professional training for people working in the film and television sector. It is also involved in management development initiatives for groups of managers from different companies, many of which have some focus on innovation.
- Major industry organisations, including the Small Firms Association, ISME, Chambers of Commerce of Ireland and many sectoral organisations provide training to their members. Some of the training provided is in the creativity and innovation territory.

3.7.3 Direction of Policy

Networks

There has been an increasing interest in network based approaches to industry training in recent years, for a number of reasons.

- They respond to needs identified by industry, and can only operate while they continue to offer clear value to industry.
- They overcome a problem that many industry organisations have, that their members are prepared to pay for training, but may be more reluctant to fund the administrative resources required to make it happen.
- Networks form a relatively efficient means of delivering training. They aggregate demand from a number of companies together, which is more efficient than delivering training to individual companies. In many cases, also, networks organise events that provide effective learning opportunities without the presence of professional, paid trainers.
- In training and other events organised by networks, participants often learn a considerable amount from their peers. This is particularly important in the arena of creativity and innovation, which benefits strongly from diverse perspectives.

Part Time Education

The Irish higher education system has progressively become more actively involved in part time education in recent years. This trend is continuing as colleges engage more effectively with industry, and reorganise in ways that are friendlier to part time study. One of the main barriers to further developments in this area is that fees are charged for part-time education, which is particularly an issue for first time undergraduates.

Open Access Interventions

Internationally, agencies concerned with disseminating knowledge to large numbers of businesses, such as the Small Business Administration in the US, increasingly present information and learning materials online. While this is less effective than an in-person intervention, it is also much less costly. It opens up access to information to a much wider population of businesses than can be reached through direct or network training interventions.

Management Development Council

The Management Development Council (MDC) is currently finalising its report and will shortly be making recommendations to the Tánaiste and Minister for Enterprise, Trade and Employment on a strategy for management development in Ireland. A significant part of the learning required in creativity, design and innovation falls within the area of management development, The Management Development Council has recognised the importance of creative, design and innovation skills for the successful management and development of companies – CDI skills have been included on the MDC's 'competency framework' which captures the attributes all managers should ideally possess. There is a need, therefore, to ensure that management development programmes incorporate modules into their offerings that enhance the CDI capabilities of Irish managers.

Workers with Low Skills / Low Qualifications

There is an increasing policy focus on boosting the skills of employees with low skills and/or low qualifications, with much of the focus being on generic skills, including literacy and numeracy. The motivation for this is to boost their employability, and to overcome the pattern whereby the least skilled and least qualified receive the least continuing education and training on average, adversely affecting their employability and career prospects.

This has positive spin-offs for the capability of these employees to participate in workplace innovation.

3.7.4 Conclusions

The optimal mechanisms to be used in delivering training in creativity, design and innovation are likely to be:

- Continuing the delivery of most Enterprise Ireland client services, including training, as at present;

- A much greater use of networks, whether formally designated as learning networks as in the case of Skillnets training networks, or as innovation networks in the case of Enterprise Ireland networks;
- Responses by higher education institutions to perceived demand for part time education in areas related to creativity, design and innovation;
- A web-based open access initiative in creativity, design and innovation; and
- Leveraging mechanisms to be developed at the initiative of the Management Development Council.

Centre for Design Innovation

Funded by Enterprise Ireland under the Applied Research Enhancement Programme, the Centre for Design Innovation is based at IT Sligo Business Innovation Centre, with a brief to promote innovation in industry through design. The Centre has been in existence for approximately two years. One of its major initiatives has been a programme to bring design thinking to organisations in the Northwest, starting with presentations to a wide population of businesses, undertaking short in-company interventions with a narrower population, and then undertaking in-depth interventions with six organisations over a period of 18 months.

Examples of the benefits organisations have gained include the following:

- *A mould-making company developed a much more easily used manual, along with a laminated quick-start guide, making its technical documentation much more accessible to production workers than that of its competitors.*
- *A crane company identified opportunities to produce a more reliable and user friendly remote control, to boost customer service performance at head office, and to improve its next generation crane design.*
- *A software company that provides online marketing applications identified a large number of small improvements that it could make to produce major improvements in the user experience, and identified a need to rebrand.*

Abstracted from Innovation by Design – Irish Companies Creating Competitive Advantage, Centre for Design Innovation, 2008

3.8 Clustering and Cultural Life

In addition to the contexts of the individual firm and the individual industry, the wider economic and cultural context can affect the supply and quality of skills in creativity, innovation and design.

Various writers on industry clustering and agglomeration connect innovation in a region with concentrations of businesses in related industries, also known as clusters. While many of the factors driving this are not specifically related to skills, skills do play a part, as clusters develop specialist education and training infrastructure including universities, research institutes, industry organisations and private training firms that raise the quality of the stock of human resources above what is available to competing industries in other regions.

For this reason, an important question connecting skills and innovation is how strong the specialist education and training infrastructure is for major Irish industry clusters relative to competing clusters overseas. Given that much of the relevant infrastructure is funded by the State, rather than directly by industry, another key question is how tightly the infrastructure's activities are tied to industry needs.

This study has not undertaken an industry level or cluster level analysis that would allow such an evaluation, but such an analysis might form a useful part of the future research agenda.

Within this literature, Richard Florida is prominent as a writer on agglomeration of cultural industries, with his work describing the "creative class", and how cities with a strong creative class can prosper. He asserts that cities with high concentrations of high-tech workers, artists, musicians, lesbians and gay men, and "high bohemians", usually have a higher level of economic development. He suggests that the creative class fosters an open, dynamic, personal and professional environment, which in turn attracts more creative people, as well as more businesses and sources of capital. He suggests that attracting and retaining high quality creative talent is important to city development, even where it is not directly employed in high added value industries. Thus, for example, a thriving artistic and theatre scene contributes to development by attracting other creative talent. While his work is not without critics, it is worth considering broadly how well Ireland performs as a centre for talent.

A number of positive observations can be made about this.

- Ireland has a fairly well developed arts strategy, both nationally and at the level of many local authorities.
- Independent artists, galleries and theatres have thrived in Ireland in recent years, as demand for cultural goods and services has increased with increasing disposable income.
- Ireland has had considerable success in attracting highly qualified young people from overseas into industries including software and financial services in recent years, which is very much the sort of outcome that Florida would predict for a region with a strong creative class.
- Ireland has substantial and growing further education and higher education provision in the arts and creative disciplines. As of March 2007, there were 1,856 students enrolled on full time undergraduate courses in fine arts, music and performing arts, audio-visual techniques and media production and design – 2.7 percent of the total across all disciplines[33]. While this study did not seek to quantify supply and demand, no sense of a great mismatch emerged from interviews when the topic was discussed[34].
- A number of cities in Ireland, notably Dublin and Galway are well known as being attractive to young people as places in which to live, work and socialise.

33 HEA statistics.

34 However, specifically within product design, there is significant outward migration, apparently arising from limited domestic demand for graduates in this area.

- There are a number of initiatives in place to support the development of industry clusters, notably the Digital Hub, a Government-sponsored commercial public-private partnership, with 90 companies and 700 employees.

However, there are issues with the built environment and with the country's telecommunications infrastructure.

- Low housing density and high commuting times mean that people have less time and opportunity to socialise, and engage with the creative endeavours accessible in our cities. This limits the scope for people to spark off each other creatively, and contribute to driving innovation.
- Weaknesses in the country's telecommunications infrastructure have slowed adoption of broadband by households, and have limited bandwidth, compromising the speed of adoption of new technologies for communication and cooperation. This again limits scope for people to spark off each other creatively, and cooperate in driving innovation.

Thus, while in many respects Ireland performs well against Florida's frameworks, the built environment and shortcomings in telecommunications infrastructure pose challenges for Irish creativity and innovation.

In an interesting paper from 2007, Bettencourt et al looked at the relationship between city size and creativity, innovation and productivity[35]. According to the paper, many characteristics of cities vary in a non-linear manner with population. The number of petrol stations and road surface per inhabitant in larger cities is less than in smaller cities, while the number of patents, inventors, R&D staff and "supercreative" employees per inhabitant is greater. On average, the bigger a city is the more creative and innovative its inhabitants are.

For example, based on an analysis of US data, the paper found that private R&D employment increases to the power of 1.34 with increasing city size. This means that on average a city that is twice the size of another will have 2.5 times as many people employed by the private sector in R&D. Similarly, it will produce 2.4 times as many patents, have 2.2 times as many people in "supercreative employment", and (based on EU data) produce 2.4 times as much GDP.

This may have implications for Irish spatial strategy, favouring a smaller number of larger centres, favouring the continued (if more compact) growth of Dublin, and favouring tighter integration between those centres that are distant from Dublin, as with Atlantic Corridor initiatives.

3.9 Progress on Recommendations of Past Reports

This section highlights key recommendations from past reports that are relevant to the current study, and reviews to what extent they have been implemented.

The **ICSTI Statement on Design and Development**, published in 2002, is the main existing report addressing the role of design in Ireland. The main relevant recommendations in the report are:

35 Growth, innovation, scaling, and the pace of life in cities, Bettencourt et al., PNAS, April 24, 2007, vol. 104, no. 17, 7303

- **Positioning Ireland as a design leader** - Design should be a key element in future enterprise development policies; a minister in DETE should be give responsibility for design development and implementation; financial support should be provided to support designers in house in SMEs, supporting the cost of employment for two years; support should be provided for prototype production and market visits to conduct user research.
- **Promoting awareness of the strategic use of design** – There should be a programme to promote design to industry, to create awareness among design consultancies of the availability of State support for design as part of R&D, and to coordinate design promotion activities of state development agencies.
- **Enhancing state support infrastructure for design** – Enterprise Ireland should extend its design promotion work to all client companies that would benefit from it; design graduates should be placed in industry, with mentor support; state development agencies should encourage firms to integrate strategic design considerations into their business plans and bring forward proposals for funding design and development initiatives; resources should be made available to support the Design Shannon initiative; clients of County Enterprise Boards should be able to access information and supports on design.
- **Design education at primary and second level** – NCCA should be given the resources to implement and oversee a pilot project to improve teaching of design at primary and second levels, and to increase the awareness of design courses among guidance teachers and teachers of subjects with a design component; EGFSN should develop information sheets on 3rd level industrial design courses.
- **Design education in higher education** - Design should be made an integral part of undergraduate and postgraduate management courses; product design and technology courses should be introduced at undergraduate level, with a strong applied element such as placements in industry and project work; there should be a Masters level course in design at a higher education college in each province.

There has been some progress on these. Design now has a more prominent role in Enterprise policy, with Enterprise Ireland now frequently providing support for design consultancy as a part of company interventions, and supporting the Centre for Design Innovation. Skillnets supports a number of industry training networks focused on design, including Design Shannon. However, it would be an exaggeration to suggest that Ireland is now positioned as a design leader. There is clearly much more that could be done to promote awareness of the strategic use of design.

While the specific recommendations regarding primary and second level education have not been implemented, there have been positive developments at second level. Very positively, the obsolete Leaving Certificate course in Technical Drawing has just been replaced by a course in Design and Communication Graphics. A new curriculum in Art has been developed, and is awaiting funding.

New courses in product design have been introduced in a number of higher education colleges. However, there is still very limited activity at master's level, and design has not penetrated undergraduate or postgraduate management courses to any great extent.

A number of reports have addressed Ireland's innovation skills needs. These include:

- Services Innovation in Ireland – Options for Innovation Policy (Forfás, 2006)
- National Competitiveness Council Statement on Innovation (NCC, 2004)
- Innovate, Market, Sell: A Review of the Sales, Marketing and Innovation Capabilities of Irish Exporting SMEs (EGFSN, 2004)
- Strategy for Science, Technology and Innovation 2006-2013 (DETE, 2006)

Services Innovation in Ireland – Options for Innovation Policy calls for:

- "Increased capacity and capability for creativity at all levels including from schools, Institutes of Technology and locations where businesses can be trained and supported"; and
- "Embedding of creativity techniques into education and lifelong learning courses – linked to centres of excellence where businesses can be trained or facilitated in creative thinking regarding innovative services, customer interfaces or business models".

There are developments underway that address these recommendations in part. School level reforms described earlier are intended to increase capacity and capability for innovation. It is also possible to identify initiatives at higher education level, both at universities and Institutes of Technology that favour increased creativity, although their overall system-wide impact is patchy. The extent to which creativity techniques are embedded into courses for business and lifelong learning provision is also patchy.

The *National Competitiveness Council Statement on Innovation* does not say much directly about skills, but addresses topics that intersect with skills issues. The main recommendation that it makes that directly concerns skills is that "courses which encourage and indeed introduce key entrepreneurial skills need to be implemented at various levels of schooling". The proliferation of form-a-business projects at transition year in second level goes a limited way towards addressing this recommendation.

Key recommendations in areas that intersect with the skills agenda are in:

- Developing technology transfer to industry from higher education institutions, including development of a technology transfer network;
- Developing industry clusters, putting in place cluster infrastructure, and matching the research work of higher education institutions with clusters.

There has been some progress in these areas. There is significant further policy work underway on interaction between industry and higher educations. There are a number of initiatives that support the development of industry cluster infrastructure, notably Enterprise Ireland's Innovation Networks initiative.

Innovate, Market, Sell makes the following recommendations that are relevant to creativity and innovation:

- Make industry placements an essential part of all business, marketing and sales degree courses;
- Improve networking between higher education institutions and SMEs, e.g. by increasing and pooling the resources allocated to industry liaison;
- Incorporate marketing and sales modules in curricula of technical disciplines in higher education institutions; and
- Develop training programmes to up-skill sales personnel from a technical background in sales and marketing competencies.

The main progress that has taken place is that networking between higher education institutions and companies generally, including SMEs, has improved since the report was published, in areas including continuing education and research.

The *Strategy for Science, Technology and Innovation 2006-2013* planned a considerable number of developments that are relevant to skills in innovation. These were in the following areas:

- Increased participation in the sciences by young people; further develop the full range of awareness raising activities under Discover Science and Engineering. (Progress: progress on this is limited so far; Discover Science and Engineering is undertaking research into what actions may be effective in promoting interest in science and technology).
- Significant increase in the numbers of people with advanced qualifications in science and engineering; double the number of PhD graduates by 2013 (Progress: growth in higher education research is sharply increasing the number of graduates with research degrees).
- Build on recent NDP investments to deliver a sustainable, world class research system across the spectrum of humanities, physical and social sciences (Progress: evaluations of research show progress towards a world class research system).
- Enhance postgraduate skills through a graduate schools mechanism (Progress: graduate schools are being established).
- Develop sustainable career paths for researchers; enhance the mobility of researchers (Progress: report on researcher careers published by Advisory Science Council and Forfás, October 2008).
- Ensure that HEIs encompass IP management and commercialisation as a central part of their mission, equal to teaching and research (Progress: technology transfer offices and policies established in higher education institutions).
- Increase absorptive capacity by strengthening technology skills in firms new to R&D (Progress: addressed within company development interventions by Enterprise Ireland).
- Promote the formation and advancement of inter-company networks (Progress: Enterprise Ireland establishing sectoral innovation networks; Skillnets funding training networks specialising in creativity, design and innovation).
- Strengthen measures to increase interaction between firms and higher education institutions nationally and regionally; develop additional competency centres in strategically important

technologies, with significant expansion of industry linkages (Progress: links between industry and education have strengthened).

- DES to review the implementation of the primary science curriculum to ensure the new curriculum and teaching methodologies are stimulating interest in and awareness of science at a very young age (Progress: NCCA has undertaken research into science learning as a part of the Review of the Primary Curriculum).
- Science and awareness of scientific issues to be a core area of study for student teachers in Colleges of Education (Progress: science is not a core subject for student teachers; for example, bioscience is a first year option at St. Patrick's, Drumcondra).
- Reform the maths and science curricula starting with physics and chemistry subjects in Leaving Certificate to ensure a continuum from junior cycle with the emphasis on hands-on investigative approaches and the completion and assessment of practical coursework (Progress: Review of Mathematics undertaken by NCCA, leading to the launch of Project Maths in 2008; curricula in physics, chemistry and biology are being reviewed by NCCA).
- Invest in teacher professional development in collaboration between second level in-service providers, higher education institutions and the Discover Science and Engineering programme, as appropriate (Progress: the main focus of Discover Science and Engineering in teacher education is at primary level, through Discover Primary Science; there is some involvement with second level through Discover Sensors and Nanoquest).
- At the Transition Year, the promotion of information brochures, guidance materials and resources and awareness initiatives in collaboration with the Discover Science and Engineering programme, and effective linking of this with school guidance services (Progress: The science.ie web site operated by Discover Science and Engineering provides careers information).
- Survey pupil attitudes to the revised junior cycle syllabus in 2006 (Progress: pupil attitudes to the syllabus have been surveyed as a part of a consultation on the rebalancing of the Junior Cycle syllabus undertaken by NCCA).
- Support the development of teachers' networks which will focus on improving teaching and learning, including the Continuing Professional Development of teachers (Progress: teacher networks have become central to the way in which NCCA operates).

Chapter 4 Conclusions and Recommendations

4.1 Introduction

This chapter summarises the report's conclusions, and presents recommendations based on those conclusions.

The report has not identified major requirements for new institutions or for new spending programmes. The institutional arrangements required to implement the recommendations are largely already in place. The actions recommended fit naturally into existing programmes, or can be made to fit. The main message is about raising the priority accorded to skills in creativity, design and innovation within existing spending programmes, rather than seeking substantial new funding.

Thus, the report can be seen as primarily being about sharpening the strategic focus of existing programmes, to maximise their impact on Irish productivity, and therefore their long term economic impact.

The recommendations being made complement the Expert Group's existing findings and recommendations on skills and learning needs, which are also relevant to building an economy based on creativity and innovation. The need to achieve the objectives identified in this report is in line with the thrust of the Strategy for Economic Renewal published by the Government in December 2009.

The recommendations being made also take into account the changing circumstances in which Ireland now finds itself, even since work on this report was being finalised. We have therefore focused on recommendations which it is believed will provide the greatest impact in fostering creativity, design and innovation, at a time when these talents are urgently required for economic recovery. We also believe that it is realistic to suggest that these can be achieved within the context of existing strategic aims and budgetary constraints.

On this basis, in the recommendations section we are identifying actions in the order of priority within which they should be pursued. The conclusions section indicates other areas of recommended action which should be also be taken, as and when more favourable economic conditions for so doing prevail.

4.2 School-level Education

4.2.1 Primary

Primary education appears to be broadly on the right track in developing creativity, and the foundations of skills in design and innovation, although there are still some implementation problems at school level.

The Expert Group supports the work of the National Council for Curriculum and Assessment and the Schools Inspectorate at primary level in developing key skills that underpin the readiness of students to engage in creativity, design and innovation.

We are aware that the question of whether or not class size might have a bearing on fostering the kinds of learnt behaviours this report is recommending is one on which views differ. In view of this, we believe that a more detailed examination of the issue would provide a useful contribution to policy planning and for determining in a more definitive way the extent to which it is a significant factor in achieving the objectives, both of this report and more generally.

4.2.2 Second Level

The contribution of second level education in Ireland to promoting creativity and innovative capability among students is a complex matter.

- On the one hand, considerable work has gone into developing the second level curriculum, much of it supportive of developing creativity and higher order thinking skills among students.
- On the other hand, one of the most consistent messages from interviews with industry and higher education undertaken for the study is that they see problems with the preparedness of school leavers to contribute to innovation.

We are aware of the variety of demands that are being sought of the second-level system simultaneously. However, we believe it is possible to encourage creativity and innovation without necessarily involving major changes. Current curriculum developments already go some way toward doing so and show a good deal of promise for getting around the constraints posed by the public examinations system.

With this in mind, at second level we believe that ways in which this can best be achieved might include:

- Being embedded in all aspects of learning across all subjects, particularly through use of methods such as project work; and
- Ensuring the benefits of transition year through a quality assurance process.

4.3 Further Education and Training

One of the positive outcomes of the introduction of the National Framework of Qualifications has been to ensure that personal development modules, which develop generic skills that are required to underpin creativity and innovation, have become a core part of further education and training courses where they were not already present. However, there is generally a need to adapt these modules to the subject matter of courses, to hold student interest, and to maximise the likelihood that it will be internalised, and this is not always done.

The extent to which other components of further education and training courses promote creativity and capability to innovate varies greatly. Courses in art, design and other creative disciplines are mostly very strong in this area. Some courses feature significant independent learning through project assignments. Others, for example in childcare, feature a requirement for reflection with a view to improving understanding and performance. However, many courses appear to do little to develop creativity, focusing very much on developing specific skills.

While FETAC has improved matters significantly by requiring that courses include generic skills modules, there is a need to go further by specifying that these should be taught in a way that links tightly to the main subject matter of the course, and that teaching methods for at least some other modules on each course should be designed to promote creativity and innovative capability.

4.4 Higher Education – Taught

Higher Education – Taught encompasses

- Undergraduate "third level" education (primarily Higher Bachelors Degrees, Ordinary Bachelors Degrees and Higher Certificates); and
- Those parts of postgraduate "fourth level" education (primarily taught masters degrees and postgraduate diplomas) that are taught in format.

Taught Courses in General

There is considerable variation in the extent to which higher education taught courses in Ireland develop creativity and capability to engage in innovation among their students. This issue is not specific to particular institutions or to particular disciplines.

While there can be a place for specific courses focused on topics such as creativity and communication skills, the primary need is for development of skills relating to creativity and innovation to be embedded into the learning approaches used for the main content of the course of study. There is a discussion of the ways in which this can be achieved within the body of the report.

Key approaches include (inter alia):

- Greater use of team-based project work;
- Inter-disciplinary project work with students from complementary disciplines;

- Problem-based learning and inquiry-based learning; and
- Flexibility for students to take some courses outside the main discipline they are studying.

The first three of these approaches rely on small group teaching.

There is room within these approaches for more cross-disciplinary work between disciplines within broad groups, such as within science, or within humanities. However, the greatest need is for projects that cross very different disciplines that complement each other in the workplace, such as, for example:

- Business and science;
- Engineering and business; or
- Computing and design.

Taught Courses in Creative Disciplines

Many higher education courses in design and other creative disciplines have not gone through any thorough process of re-evaluation in recent years. This report has identified a number of areas outside the traditional mainstream of such courses that are becoming increasingly relevant when creatives enter employment or start up in business on their own behalf.

The responsible higher education institutions should review courses in design and other creative disciplines to identify whether they should modify them so as to better prepare students to form an effective part of an innovating team, or to develop business skills to complement their creative skills. They should consult with relevant professional and industry bodies on course design. They should source expertise in business learning appropriate to their students' needs, whether from business academics in the same (or a related) institution, from providers of start-your-own business courses, or indeed in some cases from their own resources.

Design in Business Education and Training

While user-centred approaches to innovation are recognised as important in the business literature, and while design is the discipline with most to say on this topic, there are few cases where business courses include substantial design content. Some design content (particularly product design) would fit logically into courses in business strategy, marketing, business information systems and technology management, as well as into general business studies courses.

Higher education institutions providing courses in business should teach the design thinking perspective, and should include design modules in courses in business strategy, marketing, business information systems and technology management.

4.5 Higher Education by Research

This section addresses postgraduate "fourth level" education pursued through research (primarily research masters degrees and PhDs).

Research Degrees in SET Disciplines

The initiatives taken by the higher education system to add professional development courses and modules to PhD research programmes are very positive from a creativity and innovation perspective.

There is a need to go further, to tackle a disconnect that exists between science, engineering and technology (SET) disciplines at graduate research level on the one hand, and business on the other, in order to develop the mutual empathy and understanding between business graduates and research SET graduates that is required if Irish research is to become more successful at spinning out start-up businesses.

Higher education institutions should continue to develop and operate professional education modules for their PhD students, and research funding bodies should continue to support student participation in these programmes. The State should continue to support innovation in the area through the Higher Education Authority's **Strategic Innovation Fund (SIF)**, through future rounds of the Programme for Research in Third Level Institutions (PRTLI), and through any further rounds of the **Graduate Research Education Programme (GREP)**.

Schools of management, and of art and design, should upgrade the priority that they place on research, with a view to making a greater number of successful submissions for funding. As research develops in design and the creative arts, it will be important that research students in these disciplines engage also with business disciplines.

The Departments of Education and Science and of Arts, Sports and Tourism should explore viable ways to fund creative arts research.

Consistent with the fact that it is one of a number of funding agencies active in SET research, Enterprise Ireland should look at the possibility of also becoming one of the agencies regularly funding research into management practice, as a means of encouraging business schools to focus on research applicable to business creativity and innovation, and more generally on ways to improve Irish management practice.

4.6 Enterprises

There is a general need for enterprises to focus more explicitly on the skills they need to foster creativity, and to innovate effectively. Where absent, there is a need to adopt management approaches that are supportive of creativity and innovation focused on the business's objectives.

Key areas businesses need to address in skills development include (see Figure 2.1 earlier):

- Generic skills – ensuring that employees have the skills in areas such including communications, teamworking and problem solving that they need to participate effectively in creative and innovative endeavours;
- Depth and diversity of expertise – ensuring that employees have sufficient depth of skills and knowledge to participate in innovation, and also that there is a diversity of different expertise and different perspectives;
- Capability to work with others – ensuring that people from different backgrounds and different business functions have the capability to work together, inspire each others' creativity, and cooperate in implementing and commercialising the products, services and processes that they invent;
- Practising creativity – giving people space, permission and resources to practise innovating, both for the sake of what they create, and to build their capability to tackle new and tougher creative and innovative challenges;
- Tools for creativity – teaching people techniques and frameworks to assist them in analysis, creativity and innovation; and
- Innovation management – teaching managers, supervisors and others in leadership positions how to manage creativity and innovation, balancing the need for positive and possibly disruptive change with the equal need for coherence in direction, proper risk management and effective management of change.

To support the development of skills in these areas, and to make best use of the skills developed, businesses need well developed policies and activities in the following areas.

- Lifelong learning – encouraging employees to continue learning, and facilitating them in doing so; improving their skills in any or all of the areas described above;
- Participative management – managing the business in a manner that permits and encourages creativity and innovation, within a framework that focuses it on the business's innovation needs; and
- Crossing functional barriers – organising the business so as to facilitate interaction and cooperation targeted on innovation across functional boundaries, bringing people with complementary skills and knowledge together.

4.7 Supports for Enterprise Skills in Creativity, Design and Innovation

Networks for Creativity, Design and Innovation

Industry networks offer good potential to efficiently reach a relatively wide population of businesses with learning interventions focused on creativity, design and innovation. The benefits of such interventions are likely to be felt more widely than just the businesses reached directly, as knowledge spreads informally between businesses, through personal contacts, staff mobility or shared customers or suppliers.

Leveraging Existing Channels for Training those in Employment

There is considerable scope for agencies concerned with training and other learning interventions to boost development of skills in creativity, design and innovation, by:

- Adopting teaching, learning and assessment practices that develop skills in these areas as a by-product of achieving their more specific skills development objectives; and
- Prioritising interventions specifically designed to develop skills in creativity, design and innovation.

FÁS should:

- Review existing training programmes run in-house and by contractors, to assess how well they contribute to developing creativity and innovative capability, while meeting their specific skills development objectives;
- Consider the need to develop skills in creativity, design and innovation, as described in this report when prioritising the allocation of resources between different interventions; and
- Build requirements to develop creativity and capability to be innovative into the learning outcomes specified for courses, and make explicit reference to developing skills in these areas in the assessment process for the Excellence Through People awards.

County Development Boards should:

- Review existing initiatives targeted on entrepreneurship and support for business start-ups to assess how well they contribute to developing creativity and innovative capability, while meeting their specific development objectives; and
- Consider the need to develop skills in creativity, design and innovation, as described in this report when prioritising the allocation of resources between different interventions.

Workplace Innovation

One of the key areas where lifelong learning, participative management, and crossing functional barriers can come together across a business is in workplace innovation programmes. State agencies have a long history of supporting such programmes, under labels such as World Class Manufacturing, Total Quality Management, Kaizen, Lean Manufacturing or Six Sigma. While often having quite a low profile, programmes such as these have played a critical role in bringing innovation into Irish businesses over approximately the last decade and a half, and, both directly and through demonstration effects, have made a major contribution to productivity improvement nationally.

Workplace innovation programmes have an important role to play in leveraging the creativity of people from all parts of an organisation to drive innovation. They typically include a significant training component, and bring people together across functional boundaries.

The key programme currently operating in this area is the Workplace Innovation Fund, operated by Enterprise Ireland and the National Centre for Partnership and Performance. This programme, which is limited in scale, is primarily targeted on Enterprise Ireland clients.

The network model offers an opportunity to bring this approach to innovation to a broader population of businesses than are targeted by the Workplace Innovation Fund. Indeed, there are already a small number of Skillnets networks focused on this area.

The National Centre for Partnership and Performance should consider partnering with Skillnets and other relevant bodies on a Workplace Innovation Network initiative, to complement Workplace Innovation Fund initiatives.

Design Placement Programme

Irish industry is, on the whole, weak in product design, and needs a skills boost in this area. The problem is not a lack of people with suitable skills at graduate level. Indeed, many of our graduates in product design are migrating overseas because there is insufficient demand for their skills in Ireland. The problem is more one of a lack of design thinking in industry, and a lack of understanding on the part of businesses of how to leverage design into value-adding innovation.

Ireland has faced similar issues before with getting technology skills and marketing skills into small and medium businesses, and has sometimes responded by using graduate placement programmes to support businesses in taking on graduates with these skills. The Export Orientation Programme (EOP), which places graduates into overseas marketing roles, and supports them with continuing education, is still in operation, operated by IBEC on behalf of Enterprise Ireland.

Management Development Council

There is a more general need to educate managers in innovation management and design thinking, as a standard part of their base of professional skills and knowledge. This forms part of a broader requirement to develop management skills, particularly in Small and Medium Enterprises. This broader need was addressed in the Expert Group report on *SME Management Development in Ireland* (2006).

As the broader requirement now falls within the remit of the Management Development Council, and as the Council is currently working on strategies to address it, it is appropriate that this report should primarily highlight the need for action in the area.

The Management Development Council should place a high priority on educating managers in innovation management and design thinking.

Open Access Intervention

There is a need for an instrument to reach businesses beyond the number of businesses that can practicably be reached through network-based interventions and through direct company development initiatives by the development agencies.

A web-based portal on skills, frameworks and best practices in creativity, design and innovation should be developed and promoted to Irish industry. This could have a good fit with a "virtual networks" initiative. If the portal fits into the strategy to be recommended by the Management Development Council, then it should be implemented as a part of that strategy.

4.8 Design Infrastructure

Many other countries have recognised the importance of design to innovation, and have invested significant amounts in State interventions to promote design. Typical interventions include the establishment of a Design Council to promote design, and the establishment of a Design Institute to function as a centre of expertise in design, with a significant amount of money sometimes going into a landmark building to house the institute.

We do not think that this approach would necessarily have a good fit with Ireland's institutional architecture. There is a need for much more activity in design, but we see at least the skills related elements of this being undertaken largely within the existing institutional framework.

Key elements to the existing infrastructure include:

- Design courses at a number of Institutes of Technology, and at the National College of Art and Design, and at a small number of universities; and
- The Centre for Design Innovation, based at Sligo Institute of Technology, with a remit to promote design with industry in the North-West region.

From at least a skills perspective, we believe it would be preferable to build organically from this base, rather than creating a new institution than might have difficulty in connecting effectively with industry, and might compete with, rather than complement, existing initiatives.

4. 9 Recommendations

Introduction

This report takes the need for skills in the specialist areas addressed by earlier EGFSN reports, and the need for lifelong learning, as established and addresses:

- The complementary skills needed by people with specialist skills to enable them to be creative, and to perform effectively as innovators;
- The skills in design that are required, whether among professional designers, or among people from other specialisms;
- The contribution that other specialist skills in the arts, humanities and social sciences can make to creativity and innovation; and
- Further measures required to develop the skills required for innovation in the workplace.

The recommendations that follow complement the Expert Group's existing findings and recommendations on skills and learning needs, which are also relevant to building an economy based on creativity and innovation. They focus on those specific actions which the Expert Group believes are realistically achievable in current circumstances and will contribute most to strengthening our creative and innovative capabilities.

Recommendation 1: The main responsibility for levelling up performance at third and fourth levels lies with colleges themselves. All Irish higher education institutions should set objectives in developing creativity and capability to innovate among their students as a part of their strategic plans and should regularly review progress against those objectives.

Other bodies can contribute to this, and indeed can provide an impetus to drive this change throughout the higher education sector.

- The Higher Education Authority should explicitly specify student creativity and capability to engage in innovation as an objective to be pursued under future **Strategic Innovation Fund** cycles. It can be used to drive, inter alia: greater use of team-based project work; inter-disciplinary project work with students from complementary disciplines; problem-based learning and inquiry-based learning; and flexibility for students to take some courses outside the main discipline they are studying.
- HETAC should review its policies on course descriptors and learning outcomes to ensure that the specifications for all courses thoroughly reflect the Framework requirement for competence in creativity. It should ensure that all reviews of courses and institutions give adequate weight to this requirement, and where possible are carried out by people capable of giving constructive criticism in the area.
- The Irish Universities Quality Board should look at issuing a Good Practice Guide in the area, similar to guides it has previously published on other topics. It should give the topic adequate weight in external quality reviews of institutions, and should ensure that it is well reflected in internal quality reviews.

- The Department of Education and Science should take account of the resourcing requirements of teaching approaches that promote creativity and innovative capability among students when reviewing funding and resourcing of higher education institutions. It should particularly support small group teaching where this demonstrably produces positive outcomes in creativity and innovative capability, and should seek to protect it when making decisions on funding of higher education institutions.

Implementing bodies: Department of Education and Science, HEA, HETAC, IUQB

Recommendation 2: Higher Education Institutions should make a major effort to break down the disconnect between SET and business disciplines.

They should start by piloting a system of joint coursework projects for PhD researchers and postgraduate business students. Institutions and funding bodies should also look at establishing industry placements for PhD researchers, and greater use of part time PhD study by people in employment. Strategic Innovation Fund, Programme for Research in Third Level Institutions and any future Graduate Research Education Programme funding should be focused on initiatives in these areas.

Implementing bodies: HEA, higher education institutions

Recommendation 3: The Expert Group supports the thrust of the work of the National Council for Curriculum and Assessment in reforming second level education. Subject to the developments described in chapter 3 working successfully, they should be rolled out widely across the full range of subjects.

More specifically:

- Subject to successful evaluation of its early implementations, it is important that Project Maths should be rolled out nationally at a reasonably fast pace.
- The Department of Education and Science should devote adequate resources to continuing training of teachers, to underpin the effective implementation of curriculum reform.
- The recommendations of the Task Force on the Physical Sciences, which address many of the key issues in creativity and innovation specific to the delivery of Chemistry and Physics curricula, should be implemented.
- The Department of Education and Science should approve the launch of the new curriculum in Art urgently.

Implementing bodies: Department of Education and Science, secondary schools.

Recommendation 4: To assist Irish businesses in assessing their skills in creativity, design and innovation using the frameworks presented in this report, and material from other sources, and to help them to respond to opportunities and deficiencies that they identify, an audit tool for this purpose should be developed.

This can then be made available to firms through multiple channels by relevant bodies and agencies. In the first instance, the development of the audit tool should be put out to tender by the Department of Enterprise, Trade and Employment.

Implementing bodies: Department of Enterprise, Trade and Employment, development and training agencies.

Recommendation 5: Skillnets and its stakeholders should place an increasing emphasis on funding networks that target skills in creativity, design and innovation.

To encourage applications, Skillnets should consider establishing a fifth pillar to its strategic framework, focused on skills in this area, and should publish guidance and case studies to inform prospective networks.

Skillnets should investigate the potential for virtual networks in creativity, design and innovation, based largely online.

Enterprise Ireland should continue towards launching its Innovation Networks Programme, and should expand it if successful.

Implementing bodies: Skillnets and its stakeholders, Enterprise Ireland.

Recommendation 6: While continuing to develop and promote the use of standard modules in personal development across different subject areas, FETAC should encourage providers of further education and training to adapt the content to the subject matter of each course.

FETAC should look at introducing a requirement that courses contribute to developing creativity and innovative capability, particularly at Level 6 where it is explicitly a part of the National Framework of Qualifications, but also at other levels. It should integrate this into evaluation processes. This would impact on continuing education and training, as well as on initial education and training.

Implementing bodies: FETAC, FETAC course providers.

Recommendation 7: Organisations such as Enterprise Ireland, industry representative bodies and relevant higher education institutions should consider introducing a placement programme for Product Design graduates, broadly similar to the existing Export Orientation Programme.

As design is a market-facing discipline, it is likely that graduates participating would engage in some overseas travel, but the programme would not include an extended overseas placement similar to that in the EOP. The programme would ideally lead to an academic award, as the EOP currently does.

Implementing bodies: Enterprise Ireland, IBEC, higher education institutions.

Recommendation 8: Agencies including Enterprise Ireland and the Higher Education Authority, as well as higher education institutions, should support the development of a strong design skills development infrastructure, building organically on the existing infrastructure.

Key areas where skills-related developments are required from this infrastructure are in:

- Connecting undergraduate design education, particularly in industrial and product design, to industry through work placements;
- Developing postgraduate design education, at both taught masters and research degree level, with more students, tighter connections with industry and with other disciplines, and ideally a national cross-institutional Graduate School Programme in Design;
- Continuing education programmes, targeted on designers, on engineers and technologists, on marketers, and on managers requiring design thinking skills; and
- Extending an in-company service similar to that provided by the Centre for Design Innovation across the country.

Implementing bodies: Enterprise Ireland, HEA, higher education institutions.

Appendices

Appendix A: EGFSN Membership

Ms. Una Halligan, Director, Government & Public Affairs for Ireland, Hewlett Packard, Chairperson

Ms. Marie Bourke, Head of Human Capital and Labour Market Policy, Forfás (also Head of Secretariat)

Ms. Inez Bailey, Director, National Adult Literacy Agency

Mr. George Bennett, IDA Ireland

Ms. Liz Carroll, Training and Development Manager, ISME

Mr. Ned Costello, Chief Executive, Irish Universities Association

Ms. Margaret Cox, Managing Director, ICE Group

Mr. Tony Donohoe, Head of Education, Social and Innovation Policy, IBEC

Mr. Brendan Ellison, Principal Officer, Department of Finance

Ms. Anne Forde, Principal Officer, Department of Education and Science

Mr. Roger Fox, Director of Planning and Research, FÁS

Mr. Pat Hayden, Principal Officer, Department of Enterprise, Trade and Employment

Mr. David Hedigan, Manager, Sectoral Enterprise Development Policy, Enterprise Ireland

Mr. Gary Keegan, Director, Acumen

Mr. John Martin, Director for Employment, Labour & Social Affairs, OECD

Mr. Dermot Mulligan, Assistant Secretary, Department of Enterprise, Trade and Employment

Mr. Frank Mulvihill, Former President, Institute of Guidance Counsellors

Dr. Brendan Murphy, President, Cork Institute of Technology

Mr. Alan Nuzum, CEO, Skillnets

Mr. Muiris O'Connor, Higher Education Authority

Mr. Peter Rigney, Industrial Officer, ICTU

Mr. Martin Shanahan, Divisional Manager, Science Technology and Human Capital, Forfás

Ms. Jacinta Stewart, Chief Executive, City of Dublin VEC

Appendix B: Publications by the Expert Group on Future Skills Needs

Report	Date of Publication
Monitoring Ireland's Skills Supply: Trends in Education/Training Outputs 2009	November 2009
National Skills Bulletin 2009	July 2009
A Quantitative Tool for Workforce Planning in Healthcare: Example Simulations	June 2009
The Expert Group on Future Skills Needs Statement of Activity 2008	June 2009
A Review of the Employment and Skills Needs of the Construction Industry in Ireland	December 2008
Statement on Raising National Mathematical Achievement	December 2008
National Skills Bulletin 2008	November 2008
All-Island Skills Study	October 2008
Monitoring Ireland's Skills Supply: Trends in Education/Training Outputs 2008	July 2008
The Expert Group on Future Skills Needs Statement of Activity 2007	June 2008
Future Requirement for High-Level ICT Skills in the ICT Sector	June 2008
Future Skills Needs of the Irish Medical Devices Sector	February 2008
Survey of Selected Multi-National Employers' Perceptions of Certain Graduates from Irish Higher Education	December 2007
The Future Skills and Research Needs of the International Financial Services Industry	December 2007
National Skills Bulletin 2007	November 2007
Monitoring Ireland's Skills Supply: Trends in Educational/Training Outputs	June 2007
Tomorrow's Skills: Towards a National Skills Strategy	March 2007
National Skills Bulletin 2006	December 2006
Future Skills Requirements of the International Digital Media Industry: Implications for Ireland	July 2006
Careers and Labour Market Information in Ireland	July 2006
Skills at Regional Level in Ireland	May 2006
SME Management Development in Ireland	May 2006
Monitoring Ireland's Skills Supply: Trends in Educational/Training Outputs	January 2006
Data Analysis of In-Employment Education and Training in	December 2005

Ireland	
National Skills Bulletin 2005	October 2005
Skills Needs in the Irish Economy: The Role of Migration	October 2005
Languages and Enterprise	May 2005
Skills Requirements of the Digital Content Industry in Ireland Phase I	February 2005
Innovate Market Sell	November 2004
The Supply and Demand for Researchers and Research Personnel	September 2004
Literature Review on Aspects of Training of those at Work in Ireland	June 2004
Financial Skills Monitoring Report	November 2003
Responding to Ireland's Growing Skills Needs - The Fourth Report of the Expert Group on Future Skills Needs	October 2003
The Demand and Supply of Skills in the Biotechnology Sector	September 2003
Skills Monitoring Report - Construction Industry 2003/10	July 2003
Benchmarking Education and Training for Economic Development in Ireland	July 2003
The Demand and Supply of Engineers and Engineering Technicians	June 2003
The Demand and Supply of Skills in the Food Processing Sector	April 2003
National Survey of Vacancies in the Private Non-Agricultural Sector 2001/2002	March 2003
National Survey of Vacancies in the Public Sector 2001/2002	March 2003
The Irish Labour Market: Prospects for 2002 and Beyond	January 2002
Labour Participation Rates of the over 55s in Ireland	December 2001
The Third Report of the Expert Group on Future Skills Needs - Responding to Ireland's Growing Skills Needs	August 2001
Benchmarking Mechanisms and Strategies to Attract Researchers to Ireland	July 2001
Report on E-Business Skills	August 2000
Report on In-Company Training	August 2000
The Second Report of the Expert Group on Future Skills Needs - Responding to Ireland's Growing Skills Needs	March 2000
Business Education and Training Partnership 2nd Forum, Dublin	March 2000
Business Education and Training Partnership Report on the Inaugural Forum, Royal Hospital Kilmainham	March 1999

The First Report of the Expert Group on Future Skills Needs - Responding to Ireland's Growing Skills Needs	December 1998

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Appendix D: Recommendations of the Task Force on Physical Sciences

1. Planning and Resources for School Science

ACTION 1.1: ENSURE THAT SCIENCE EDUCATION IS ADDRESSED IN EVERY SCHOOL PLAN

This action will ensure that all primary and post-primary schools include science education as a priority in a school plan or strategy, to be evidenced by the development of goals, defined targets, quantified resources and defined criteria for success. For this process to be effective, planning must address, not just physical infrastructure requirements, but also needs around issues such as professional development, curriculum, and science promotion. The planning activity must also capitalize on external linkages, whether with other schools, local industry, parents etc. This is necessary to ensure the maximum return on the resources committed.

ACTION 1.2: PROVIDE RESOURCES FOR PRACTICAL SCIENCE

This action will ensure adequate national provision of practical science resources, including:

- *Capital Funding:* a national plan to provide an up-to-date physical infrastructure for science in all schools science will be established. This plan will set ambitious targets both in terms of standards and implementation. For post-primary schools it will ensure the provision of state-of-the-art school laboratories and equipment before the end of 2004. For primary schools it will ensure that the necessary resources are in place to facilitate the introduction of the new science curriculum in 2003.
- *Current Funding:* realistic ring-fenced funding for science, to be provided on an annual basis to all (primary and post-primary) schools. All post-primary schools will have access to dedicated technical assistance to support practical work.

2. Equity of Access

ACTION 2.1 ENHANCED TEACHER ALLOCATION

An enhanced teacher allocation will be provided to all post-primary schools with small numbers of pupils studying the physical sciences to Leaving Certificate by providing ex-quota support to any school with fewer than 16 pupils enrolled in any Leaving Certificate physical science subject.

ACTION 2.2 INTERVENTION TO BUILD SCHOOL CAPACITY

An intervention will be provided in primary or post-primary schools where a case for additional support can be made on the basis of equity considerations. This intervention will take the form of additional support to help schools develop their teaching capacity in relation to the physical sciences.

3. Teaching and Learning of Science

ACTION 3.1: VIRTUAL LEARNING ENVIRONMENT FOR SCIENCE

This action will ensure that the maximum return is obtained on any public investment in new technologies in school laboratories. Implementation should be to be through a public procurement (tender) process overseen by the DES. A key criterion will be the delivery of maximum and immediate usability in the teaching and learning of science, within schools, teacher training and adult education. Public-private collaboration may provide the most effective model for implementation, both from cost and quality perspectives.

ACTION 3.2: RESEARCH AND INNOVATION IN TEACHING & LEARNING OF SCIENCE

This action will seek to add value to existing activities and structures. Funding will be provided to catalyse activity within particular areas seen as priorities for development from a science education perspective.

ACTION 3.3: INCENTIVES FOR RECRUITMENT & RETENTION OF TEACHERS

This action will provide funding for the provision of incentives targeted at teachers of science.

ACTION 3.4: REVIEW PRE-SERVICE TRAINING FOR PRIMARY& POST-PRIMARY TEACHERS OF SCIENCE

This action will ensure that appropriate steps are taken to address needs identified in relation to the pre-service preparation of teachers. It will ensure that providers of training are able to derive maximum benefit from actions 3.1, 3.2, 3.3 and 6.4.

4. School Curriculum and Assessment

ACTION 4.1: PRIORITISE POST-PRIMARY CURRICULUM REFORM

- Fast-track curriculum changes already identified Shorten the period for curriculum design Stream-line procedures for curriculum implementation

ACTION 4.2: ESTABLISH SCIENCE AS A CORE SUBJECT IN THE POST-PRIMARY CURRICULUM

- Science to become a core subject within post-primary junior cycle

ACTION 4.3 UNDERTAKE A REVIEW OF MATHEMATICS

Four strands of action are required:

- Investigation into the decline in mathematics performance
- Increased input into mathematics curriculum by higher Education
- Review Leaving Certificate Mathematics
- Credit for Foundation Level Mathematics

ACTION 4.4: ENSURE EQUITY OF GRADING AT LEAVING CERTIFICATE

The Department of Education and Science, as the body responsible for assessment, must act immediately to ensure comparability of grading at Leaving Certificate. Three strands of action are needed:

- Annual review of examination papers for Leaving Certificate Physical Sciences
- Establish comparability of grading between Leaving Certificate subjects
- Introduce practical assessment for Leaving Certificate physical sciences

ACTION 4.5: NATIONAL FORUM ON SCIENCE EDUCATION

- A National Forum on Science Education to be held annually (commencing 2002)

5. Promotion of Science And Careers

ACTION 5.1: COORDINATION OF PROMOTION

- Establish an integrated National Science Awareness Programme
- Industry must co-ordinate its effort Evaluate the School Guidance Enhancement Initiative
- Implement the proposal to establish a National Interactive Science Centre

6. Science Education At Third Level

ACTION 6.1 RECRUITMENT TO THIRD LEVEL SET

This action will break down barriers to recruitment by ensuring that all prospective students have access to comprehensive information about SET courses and are given the opportunity of exposure to the third level SET environment. This will include:

- Supporting school-higher education links
- Advertise courses effectively

ACTION 6.2 ACCESS, TRANSITION AND TRANSFER

This action will provide routes into higher education SET for students from a diversity of backgrounds and will enable all students to experience a smooth transition into, and flexible progression through, higher education. Particular actions to ensure this include:

- Course development for wider access and successful Transition
- Improvement of access routes for all applicants
- Greater Recognition for Prior Learning (RPL)
- Accommodation of student transfer

ACTION 6.3 RETENTION / QUALITY TEACHING AND LEARNING

This action will ensure that maximum attention is given to optimising retention by providing quality teaching and learning in SET departments. This requires support for lecturers to employ new teaching and learning techniques and to develop their own capacity to deliver quality teaching. This action will provide a mechanism for:

- Setting up of a Collaborative Teaching and Learning Centre
- Training in Pedagogy

ACTION 6.4 PHYSICAL INFRASTRUCTURE FOR QUALITY TEACHING AND LEARNING

A fund will be designated for the refurbishment of undergraduate science laboratories for the use of undergraduate SET students and for students on teacher training programmes.

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