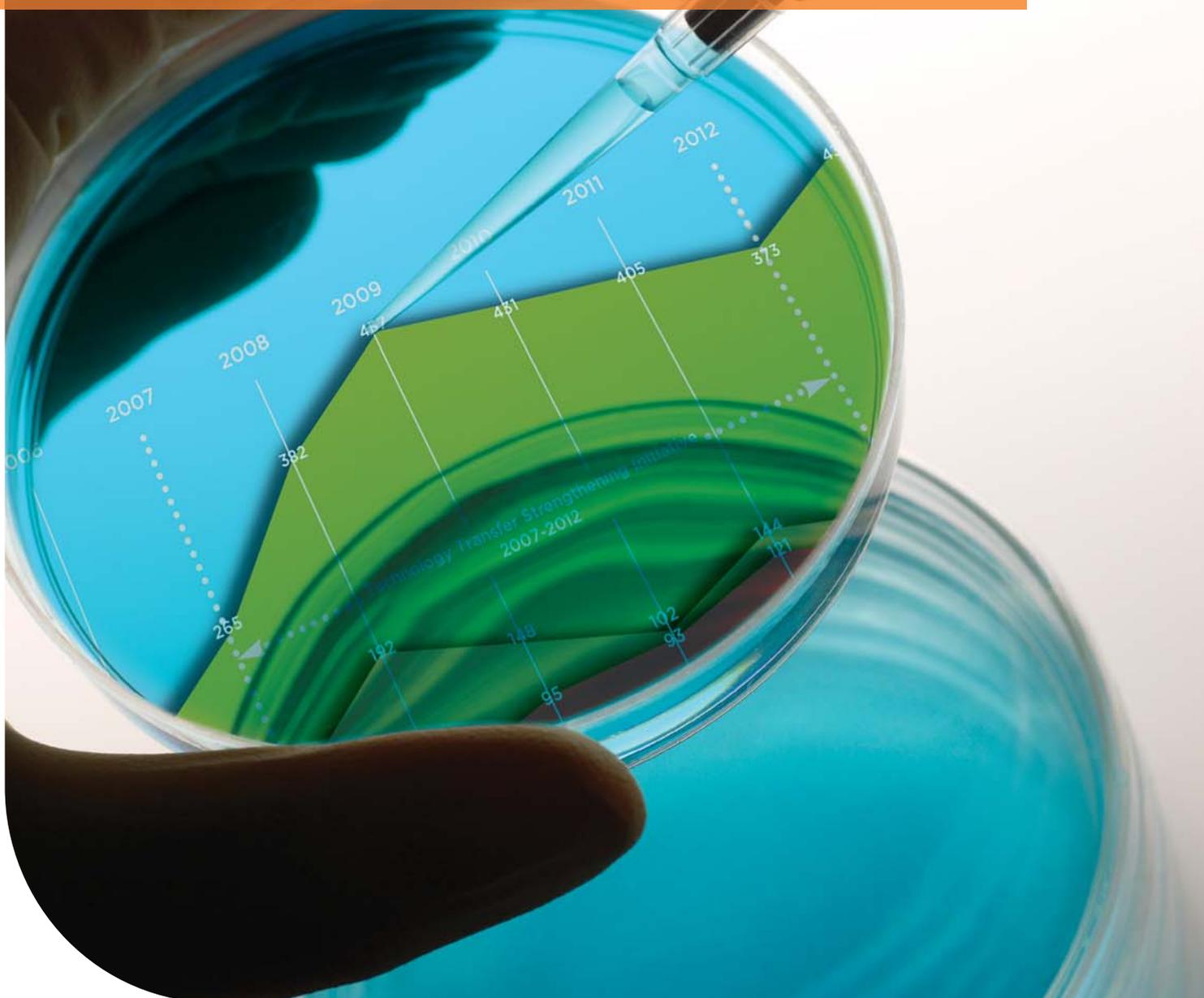


A REVIEW OF THE PERFORMANCE OF THE IRISH TECHNOLOGY TRANSFER SYSTEM 2007-2012

SUPPORTING BUSINESS INNOVATION THROUGH
ENGAGEMENT WITH IRELAND'S RESEARCH BASE



A review of the performance of the Irish technology transfer system 2007-2012

The purpose of technology transfer from the research base is to maximise the flow of technology, ideas and intellectual property (IP) into companies to bring products and services to the market for social and economic benefit.

This is the first report that includes independent evaluation to be delivered on the performance of the technology transfer system in Ireland.

It demonstrates the considerable impact of having dedicated funding to build capacity and capability within the Higher Education Institute (HEI) sector to transfer relevant intellectual IP and expertise to business.

The report presents a six year retrospective analysis of data and information collected by Enterprise Ireland, complemented by an independent study commissioned by Enterprise Ireland from the UK consultancy firm, Frontline.

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Executive summary

The period of the Technology Transfer Strengthening Initiative (TTSII) programme maps a period of evolution in the technology transfer and commercialisation system in Ireland. From a low baseline of technology transfer capacity from the Higher Education Institute (HEI) sector within the State, through the creation and management of the Initiative, Enterprise Ireland has been able to develop infrastructure within the HEI sector to support the engagement of businesses with the research base with a view to supporting those businesses that want to enhance their competitiveness.

The first Technology Transfer Strengthening Initiative programme (TTSII) was a €30 million six year programme (2007-2012). It enabled the start of a process of development of technology transfer offices (TTOs) with appropriate skills, and access to funding for the management of intellectual property (IP), to facilitate meaningful interactions with business. Prior to the programme there was little or no such capability available within Ireland's HEIs.

In 2005, prior to the introduction of TTSII, HEIs across the State transferred technology and intellectual property to business by way of only 12 licences, option or assignment agreements (LOAs) with business and spun out five new companies. By the end of the funding period, in 2012, the average number of LOAs executed each year was up over seven-fold to 85 and the number of spin-out companies created each year was averaging 22, an increase of nearly 450%.

A study of the Technology Transfer Strengthening Initiative was conducted by Frontline Consulting¹. Frontline is a policy and impact evaluation consultancy with considerable experience and expertise in providing impact evaluation and cost benefit analysis support to government departments and agencies. The study involving a sample of 65 Irish companies that had been able to access technology, IP and expertise from the Irish research base showed that these companies had created or retained 1,844 jobs which they believed were directly attributable to their ability to engage with the HEI through the TTO under the TTSII programme. Through these companies alone, a further 2,128 jobs are anticipated to be created or retained by 2017 as a direct result of the programme.

Of the businesses sampled, those that were able to share financial data collectively generated an estimated turnover of €371 million since the start of the TTSII programme in 2007. Of this, over €100 million was considered by them to be related to those technologies and processes that would not have been generated without their engagement with research teams through the TTOs.

By establishing a new technology transfer system for Ireland, TTSII has paved the way for further evolution. The national IP Protocol 2012 "Putting public research to work in Ireland" was developed by a task group comprised of leaders from industry, the investment community and TTOs. In 2013 the Government established a centralised function with responsibility for technology transfer in the State which led to the creation of Knowledge Transfer Ireland, launched in May 2014. A totally new initiative, the objectives for Knowledge Transfer Ireland are to take the guesswork out of technology transfer and to make the knowledge transfer system in Ireland one of the most transparent of its kind for businesses to leverage the commercial potential of public sector research and innovation.

There are many national success stories emanating from the TTSII programme. For example FeedHenry, Bioplastech Ltd, infiled and Surgacoll Technologies Ltd. all emerged from HEIs supported from TTSII. New propositions take time to develop, and in 2013 the hugely successful and recently acquired (for €18million by News Corp) Irish media company Storyful Ltd (the first news agency of the social media age) licensed a technology from UCD which had been in development since 2008.

TTSII was a starting point. This report offers the evidence for the importance of dedicated funding for technology transfer activity and shows the advances that can be made in a relatively limited period. It also suggests areas for further development.

By the end of the funding period, in 2012, the average number of LOAs executed each year was up over seven-fold to 85.

1 See Appendix 1

Context

In the late 1990s Ireland made a strategic decision to invest significantly in research undertaken in its Higher Education Institutes (HEIs). Major initiatives under the National Development Plan (NDP) 2000-2006 included the foundation and funding of Science Foundation Ireland (SFI) and the expansion of the Higher Education Authority's Programme for Research in Third Level Institutions.

However by the mid 2000s it became apparent that while the amount and quality of research in Ireland was rising, the commercialisation of research output was lagging behind. The Strategy for Science, Technology and Innovation (2006-2013) identified one reason as a lack of resources in HEIs to provide a robust technology transfer system. In response, Enterprise Ireland announced the Technology Transfer Strengthening Initiative in 2006 on behalf of the then Department of Enterprise, Trade and Employment. The objective of the first Technology Transfer Strengthening Initiative (TTSI1) was to drive the development of a professional Technology Transfer system within the Irish HEI sector.

Prior to the establishment of the TTSI1, technology transfer within the State was largely confined to a small number of individuals, with a range of experience levels, in the larger universities. The technology transfer offices (TTOs) or Industrial liaison Offices (ILOs), where they existed, were under-resourced and, as a result, lacked the capacity to engage effectively with either the research community or with business.

With the goal of "driving the development of a professional Technology Transfer system at our nation's public research institutions", the TTSI1 programme committed almost €30 million of State funds over an initial 6 year period (from 2007-2012) to boost technology transfer in Ireland. Funding was awarded on a competitive basis, against plans and targets from the HEIs to build and strengthen their technology transfer operations and outputs. TTSI1 funding provided direct salary and operational cost support to 10 HEIs across the State. Operational costs, patent support and access to Enterprise Ireland Commercialisation Specialists were made available to a further 14 Institutes of Technology and other Colleges. Recipient HEIs are listed at Appendix 2. In addition to these resources, Enterprise Ireland also provided opportunities for focused training and networking to share best practise.

Impact of the TTSI1 programme

Starting from a baseline of very little infrastructure and no national oversight of the technology transfer system, the aim of the TTSI1 programme delivered through Enterprise Ireland was to build capacity and capability within the HEI sector. This objective was met, delivering a resource for business to access relevant IP and expertise to enhance competitiveness.

The effect of this initiative was a substantive change in the way the State capitalises on its higher education research investment. For the first time, experienced, resourced, teams of professionals were available to act as an enterprise friendly interface between industry and the higher education system. The TTSI1 programme directly funded 32 commercialisation executive posts in the 10 main HEIs.

Under TTSI1, licensing activity increased over seven-fold from the baseline prior to introduction of the programme and spin-out company creation increased by well in excess of 400%. Of the 374 different licensees who benefitted from licences, options or assignments from the HEI sector during the TTSI1 programme, 84% were Irish based companies (316). Of these, over half (177) were Enterprise Ireland clients.

The level and quality of intellectual property (IP) captured by the HEIs and transferred to industry has increased, and through supporting the development of effective systems and policies, the programme has seeded a more consistent experience for companies engaging with HEIs.

The effect of this initiative was a substantive change in the way the State capitalises on its higher education research investment.

Performance data for the recipients of TTSII funding

For the first time the State, as result of the TTSII programme, can now systematically track the outputs from the transfer of technology, IP and expertise. This provides an evidence base for monitoring, evaluating and strategic planning for technology transfer and business-research engagement. This in turn builds investor and business confidence in the research base in Ireland.

Key metrics used to show performance change in commercialisation activity were; number of inventions disclosures to the technology transfer office (TTO); number of new patents filed by the TTO; number of licences, options or assignments (LOA) agreements contracted by the TTO; and number of new spin-out companies created.²

Performance targets for recipients of TTSII were established as part of the initial funding award process. Targets were proposed by the HEI and assessed by Enterprise Ireland and an international expert review panel. Targets were based on a variety of factors including; amount of research expenditure of the HEI, existing technology transfer capacity, previous experience in undertaking technology transfer, forward plan for development of the TTO. Metrics were monitored closely and both plans and performance reviewed by international experts at the start, during and on completion of the programme.

The outcome has been a step change in performance by the HEIs as a result of the TTSII programme as can be seen in **Figure 1**. The base figures in 2005 were five Spin-Outs and 12 LOAs (licences, options and assignments). Since the introduction of TTSII, every subsequent year has shown an increase against the base figures. On commencement of the programme the number of new innovations that were identified and protected increased. This growing pipeline of activity progressed into an increase in the number of licences from State funded research, both to existing companies and as the foundations for new spinout companies.

The number of technologies licensed to industry has on average increased more than seven fold, from 12 per year in 2005, to 87 in 2012. The vast majority of these licenses are taken up by companies in Ireland. In 2011, for example, 86% of the technology licenses went to companies based in Ireland, continuing a trend set in previous years. The number of spinouts created by the HEIs has increased on average more than four fold over the period of the programme.

On viewing the performance data across the six years of the programme in Figure 1, outputs appear to be reaching a steady rate. There was an initial surge in invention disclosure and patenting activity caused by a back log and pent up demand for the technology transfer infrastructure to service the research base.

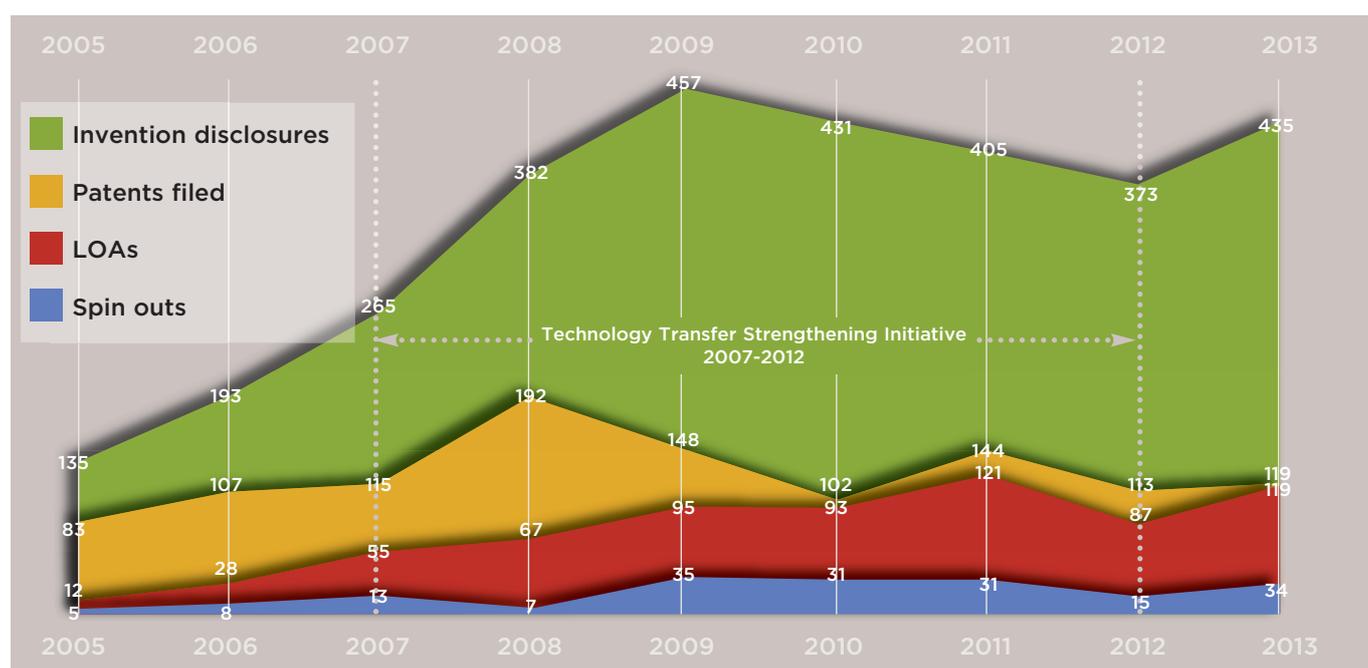


FIGURE 1: Annual performance by all HEIs³ in receipt of funding under TTSII under the TTSI programme that commenced in 2007

2 For definitions of terms see Appendix 3
 3 A full list of all 22 HEIs is available at Appendix 2

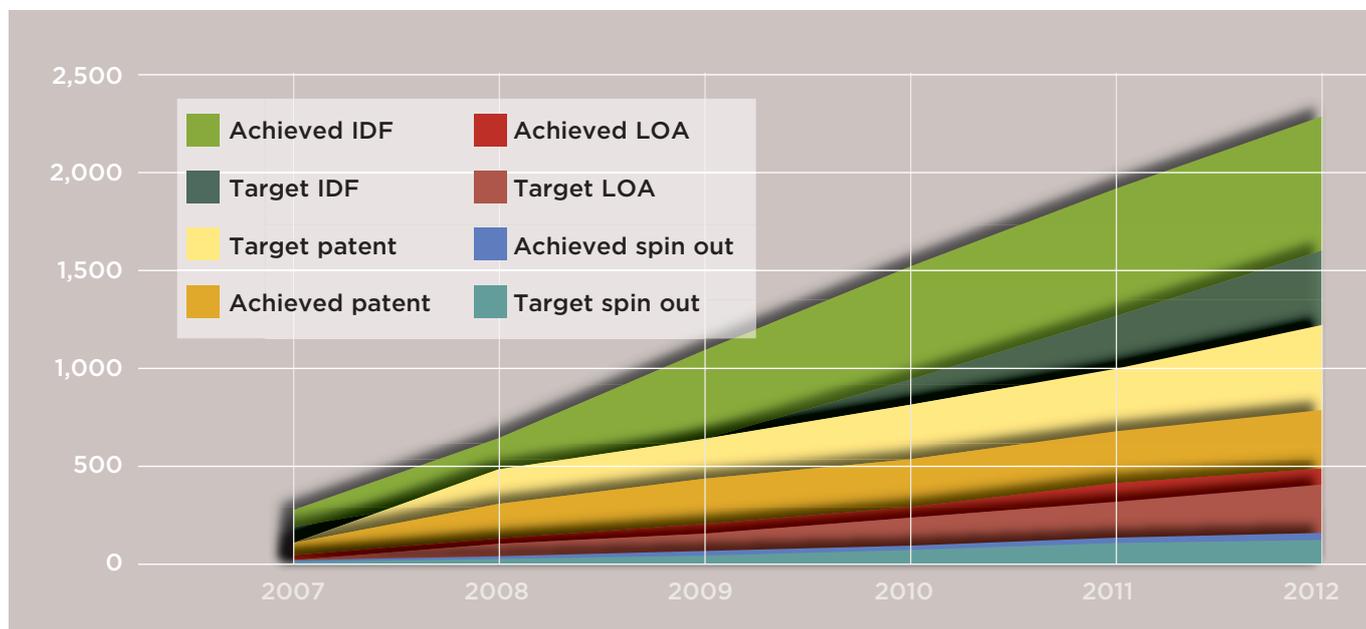


FIGURE 2: Cumulative metrics for all HEIs⁴ in receipt of funding under TTSII 2007 to 2012

The dip in 2012 can be accounted for by the knock-on effect of the flux in the funding system for research in Ireland. Funding was down overall resulting in less stability in the research base and a drop in Enterprise Ireland commercialisation funding in 2009 and 2010 also caused a fall off in pipeline projects for commercialisation. An additional factor was that 2012 saw a significant turnover of technology transfer office (TTO) staff. Uncertainty over whether the TTSI funding would continue beyond the end of 2012 caused some technology transfer staff, concerned about future employment, to leave the system. More recent metric data from 2013 have indicated a return to normal figures with increases in all metric categories compared to 2012. Performance metrics and broader indicators need to be carefully analysed and, in particular, mapped and interpreted in the context of the longer range impact from knowledge transfer activity.

Assessing performance against targets for the duration of programme (Figure 2), shows that invention disclosures and licences have been consistently ahead of target. It is pleasing to note a steady increase in licensing activity over the period of the programme as an indicator of engagement with business.

The number of patent applications began to drift below target in 2009. This is directly related to a change to the way in which funding for patent activity was managed within the programme that year. From 2009, individual technology transfer offices were given responsibility for their own dedicated patent budget rather than this being managed in aggregate by Enterprise Ireland. This led to a more diligent approach to patenting by these TTOs.

Spin-out company creation has fluctuated during the course of the programme and this is not overall cause for concern. It reflects, amongst other things, the quality of propositions available at any time, the state of their maturity and the external funding environment.

The longer term outputs from licensing and the sustainability of spin-out companies are areas for further study as we begin to move from volume to outcome assessment.

Out-turn data from the HEIs should be interpreted cautiously as they do not represent the full picture of activity. For example, TTOs are frequently engaged in negotiating research contracts with industry and supporting research funding applications to funding agencies which are not represented in data returns. Not captured is the level of engagement in more routine “research administration” activities, into which many TTOs are drawn. The increasing breadth of activity undertaken by TTOs is one to study to understand the effectiveness of service provision.

Performance is affected by the HEI environment and incentives for researchers to engage in commercialisation. A HEI that systematically fosters a culture of enterprise and out-reach to business and rewards its academics through recognition for commercialisation activities as part of the career progression pathway, is far more likely to see success. This is more than a TTO can deliver alone.

Seeding culture change

The TTSII programme has acted as a catalyst of change in attitudes to commercialisation of research within the HEIs. HEI management interviewed for the study said that attitudes to commercialisation are changing and that the pace of change is now accelerating and stakeholders felt that TTSI had done much to introduce more professional processes to support patenting and licensing. Of the sample of researchers interviewed (32), 90% said that they had a positive experience working with their technology transfer office (TTO).

The study revealed that the overall satisfaction level of business engaging with TTOs was over 86%. 50% of businesses interviewed said that they would not have developed the products and processes in question without engaging with the HEI. And a further 30% said that progress would have been far slower without HEI involvement. Businesses interviewed were satisfied with their interaction with the HEI through the TTO with 79% saying that the experience had been “good” or “very good”. 90% of the companies cited ease of engagement and 79% were satisfied with IP negotiation. See **Figure 3**. Of the 60 companies interviewed, 2/3 were in relation to engagement with four of the HEIs. This may suggest a particular satisfaction with those four TTOs.

76% of the companies interviewed were active in cleantech, ICT, electronics and engineering, pharmaceuticals and services, biotechnology, life sciences, food, and medical devices. Within these sectors, the percentage of those companies expressing a level of “satisfied” or “very satisfied” with their experience with the TTO was as shown in Table 1.

Table 1: Business satisfaction with their technology transfer experience, by sector

Sector	Company satisfaction
Cleantech	100%
Construction/consumer	100%
Electronics/engineering	92%
Pharma/services	88%
ICT	86%
Bio/life science/food	80%
Medical devices	80%

This suggests that there is room for improvement in the engagement with the bio and medtech sectors but may also reflect the fact that licensing transactions are often more complex in these fields. The greatest levels of dissatisfaction were in the ICT, electronics and engineering, and medical devices sectors at 7%, 8% and 10%.

Repeat business is an indication of a successful interaction between parties. More than 80 per cent of those interviewed said that they would work with a HEI again and, at the time of interviewing, 40 per cent have already made arrangements to do so.

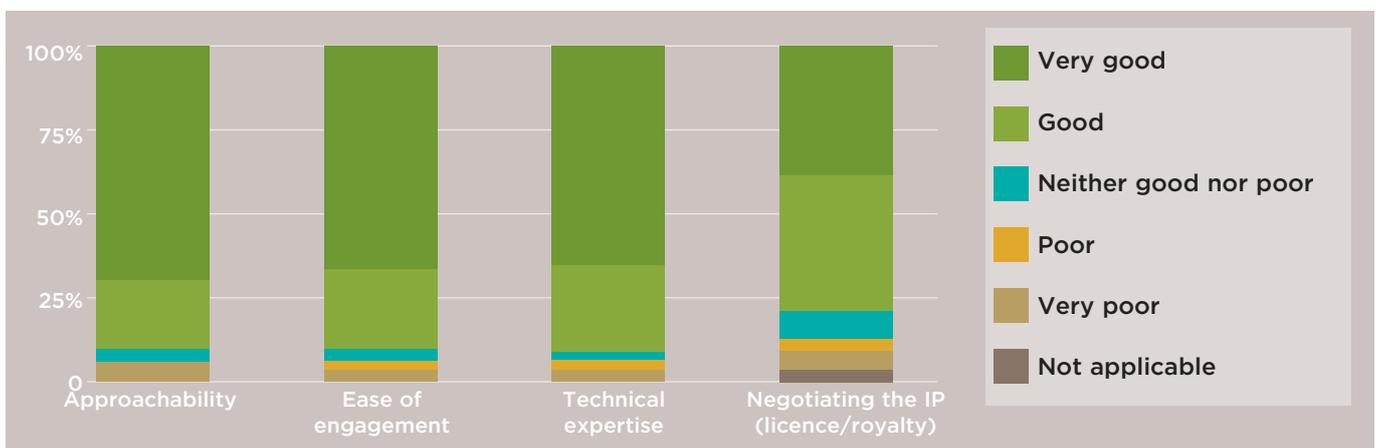


FIGURE 3: Business rating of TTO performance across key areas of activity

Stimulating jobs, supporting turnover

The study explored employment within a sample of 60 companies that had engaged with HEIs through the TTO during the period of the TTSII programme. The companies sampled were chosen across a wide sectoral base and represent those willing to engage with the consultants leading the study. Information obtained from the companies sampled showed that 1,844 jobs had been created or retained to date and a further 2,128 jobs are anticipated to be created or retained by 2017. All based on engagement with a TTO to access technology, IP and expertise from the Irish research base.

Of the businesses sampled as part of the study, 25 were willing to share financial data. These 25 companies collectively generated an estimated €371 million in turnover since the start of the TTSII programme in 2007. Of this, the companies stated that over €100 million would not have been generated without the engagement through the TTO. The study also showed that by 2017, the same businesses are expected to have generated €1.4 billion in turnover, €489 million of which it is estimated would not have been generated had they not been engaged with the HEI through the TTO.

The companies stated that over €100 million would not have been generated without the engagement through the TTO.

Conclusion

This report represents the first review to include an independent evaluation of the performance of the technology transfer system in Ireland. It combines the use of data collected by Enterprise Ireland with a study undertaken by the consultancy firm Frontline. That study probed specific outcomes from the TTSII programme. Taking the information gathered, together with experience of managing the programme over the six year period and beyond, it is possible to draw conclusions and to make recommendations.

It is clear that the introduction of the TTSII programme led to a step change in technology transfer activity in the State and allowed Ireland to begin the catch up with the majority of developed countries that had established technology transfer within their HEIs at a much earlier stage, e.g., USA, 1980; UK 1985; and, Germany 1993.

This report shows that the TTSII programme has led to the:

- establishment of a professional, resourced technology transfer infrastructure;
- impact for industry by engagement with HEIs evidenced by increased turnover and job creation; and,
- positive effect on the cultural acceptance of the necessity for and benefits of the commercialisation of research from HEIs.

By developing the technology transfer system, the TTSII programme catalysed further change in the way in which Ireland views and supports business-research engagement.

It was towards the end of the TTSII period that the national IP Protocol was published. Delivered through a task force drawn from industry, investors and technology transfer directors, this could not have been contemplated at the outset of the TTSII programme when the system was immature. This also reflects the speed of evolution of the technology transfer system in Ireland, which, in other countries, has taken far more years to develop.

Since the end of TTSII in 2012, we have seen:

- the introduction of TTSII2, a programme that continues to support technology transfer but now through consortia where the larger HEIs share resource and best practice with smaller Institutes of Technology;
- changes in the funding landscape with, for example, Science Foundation Ireland (SFI) now having a more applied research mandate, funding research centres with industry involvement and demanding performance metrics from funding recipients; and,
- the creation of Knowledge Transfer Ireland (developed from the recommendation in the IP Protocol to create a central Technology Transfer Office [cTTO]) to further facilitate the uptake by business of the technology, IP and expertise, created through State funding of research in Ireland.

In the recent EU Knowledge Transfer Report 2010-2012, Ireland was ranked first in Europe using a composite indicator of the knowledge transfer activities of public research organisations (start-ups, number of licenses, license income, research agreements, invention disclosures, patent applications and patent grants). This would not have been possible to achieve without the TTSII programme which has led to the development of technology transfer capacity in Ireland and enabled the collection of data on knowledge transfer performance in Ireland.

Whilst the EU analysis gives grounds for encouragement, there is currently a lack of sophistication in national assessments of the impact of technology transfer and so international benchmarking should be viewed at face value. For example, the EU indicators used are a mix of outputs and outcomes. Whilst invention disclosure and patent activity are an indication of innovation intent, they do not fully reflect the impact from knowledge transfer. More meaningful, but harder to measure, is the effect on the broader innovation ecosystem. But in any such studies, it should be recognised that technology transfer is just the start of a process and that commercial impacts will be determined by many downstream factors outside of the control of the TTO such as in-company development, access to capital, business to business relationships, external markets etc.

Recommendations

The TTSII programme established a technology transfer capability in Ireland that made good progress in a short timeframe. But knowledge transfer in Ireland needs to mature further. If HEIs are to continue to support business and to play their role in economic development there are four immediate things that need to happen.

1. The State needs to commit to sustain funding for knowledge transfer⁵ infrastructure so that HEIs can continue to work effectively with business and investors to see research and expertise translated into commercial success. Technology transfer is seldom self-funding and significant revenue generation often relies on a “big-win” which is unpredictable for planning purposes. The majority of international universities consider their TTOs to be service departments, working to ensure that technology and IP is driven out into the hands of companies to stimulate business innovation. For example, at Stanford only 3 out of 9,400 inventions are considered to be big winners and spin-out success is heavily dominated by one company start-up, Google. Importantly for Ireland, if the mission is to get IP and technology into companies to seed competitive advantage and to stimulate growth, then expecting TTOs to prioritise revenue generation from licensing will provide perverse incentives, at odds with economic development goals. Ring-fenced funding is critical to sustainable and successful knowledge transfer. The evaluation of TTSII provides the evidence to support this – economic and attitudinal. This has been proven in other countries, most notably the UK where the Higher Education Innovation Fund (HEIF) for knowledge transfer support in HEIs has been running since 2001. The UK is cited as the leader in KT indicator outputs in the EU Knowledge Transfer Survey 2010-12.
2. Monitoring and evaluation of the performance of knowledge transfer needs to be extended to cover the outcomes as well as the outputs (e.g. sustainability of spin-outs, company use of licensed technology). This will necessarily be quantitative and qualitative. Knowledge Transfer Ireland working as part of the Advanced Small Nations project should allow, for the first time, meaningful international comparison of knowledge transfer amongst similar economic countries.
3. Knowledge transfer needs to be embedded as a core function of an HEI, alongside teaching and research. Providing infrastructure support to facilitate technology transfer is only part of the answer. There is still a great deal of change that needs to happen. This will come through a

combination of (i) the vision of the leadership of Ireland's Universities and IoTs; (ii) concerted action from all the funding agencies to require HEIs to deliver and account for the impact from their funding and (iii) engagement in knowledge transfer used as a criterion in evaluation of academic career promotion.

4. Bureaucracy within HEIs needs to be further reduced. HEI senior management needs to recognise the investment that has gone in to building and developing a skilled knowledge transfer workforce and empower their TTOs to make and execute on commercial decisions, accepting that a degree of risk-taking is necessary if innovation from HEI research is to flourish.

If we are to realise the State's vision for Ireland to be the best small country in which to do business, our knowledge transfer system, that connects business and the research base, needs to be efficient, straightforward and effective. The ways in which business and HEIs engage need continual improvement.

We know from discussions leading to the national IP Protocol, and more recent experience in building business-HEI collaborations and new commercial propositions, that there is still more work to be done to make the identifying opportunities, and transacting and concluding arrangements swifter and simpler. Responsibility for this rests with the HEIs, government funding agencies and the business world. It will be achieved through clarity in objectives and expectations, a proper appreciation of the issues involved and a high degree of pragmatism.

We need companies, entrepreneurs, investors, funding agencies and technology transfer offices to work together to evolve Ireland's knowledge transfer system. There is appetite from these communities to continue to build from the work they undertook that led to the national IP Protocol. Taking a systems-wide approach, Knowledge Transfer Ireland will lead with this agenda through engaging with these communities and working with them to streamline the knowledge transfer system.

Priority community actions include:

- review of the IP Protocol;
- simplification of funding terms and conditions to make it easier for business to collaborate with HEIs and State research organisations; and,
- understanding performance and longer term impacts across the range of business-research engagements.

5 Knowledge Transfer (KT) includes the broader engagement with industry such as collaborative research, contract research and consultancy, in addition to the management of IP, licensing and spin-out company creation.

Appendices

Appendix 1: The Consultants

The programme evaluation was undertaken by Frontline Consulting, UK. Frontline is a policy and impact evaluation consultancy with considerable experience and expertise in providing impact evaluation and cost benefit analysis support to government departments and agencies throughout the UK, such as Scottish Enterprise and Invest NI. Frontline also has extensive experience in the Irish research landscape having carried out evaluations for SFI and Forfas as well as Enterprise Ireland. The firm has undertaken many evaluations of industry-academic research collaboration activities and this coupled with impressive technical economic skills ensured that they were the right fit for this challenging evaluation.

Appendix 2: HEIs involved in TTSI 1

The total number of HEIs receiving some level of funding under TTSI1 was 24. Of these, there were 10 major recipients of funding – for staff and operations:

- ▶ Dublin City University
- ▶ Dublin Institute of Technology
- ▶ National University of Ireland Galway
- ▶ National University of Ireland Maynooth
- ▶ University College Cork
- ▶ University College Dublin
- ▶ Royal College of Surgeons in Ireland
- ▶ Trinity College Dublin
- ▶ University of Limerick
- ▶ Waterford Institute of Technology

Cork Institute of Technology received staff and operations costs for the period 2011-2012 only.

Another 13 Institutes of Technology (IoT) and two other colleges (listed below) were also awarded funding for operational and patenting costs. They were also supported by EI Commercialisation Specialists on a case-by-case basis and by the TTSI IoT Operations Manager within EI. These IoTs and colleges did not receive salary support under the TTSI programme:

- ▶ Athlone Institute of Technology
- ▶ Dundalk Institute of Technology
- ▶ Galway Mayo Institute of Technology
- ▶ Institute of Art and Design Technology, Dún Laoghaire
- ▶ Institute of Technology Blanchardstown
- ▶ Institute of Technology Carlow
- ▶ Institute of Technology Sligo
- ▶ Institute of Technology Tallaght, Dublin
- ▶ Institute of Technology Tralee
- ▶ Letterkenny Institute of Technology
- ▶ Limerick Institute of Technology
- ▶ National College of Art and Design
- ▶ National College of Ireland

Appendix 3: Commonly used terms in technology transfer

IDF Invention Disclosure Form. A qualified written disclosure of a potential invention or new commercial proposition that is accepted into the TTO database having undergone an initial assessment for commercial potential by the TTO.

LOA Licence, Option or Assignment. A contract executed with a third party (business) to pass on certain rights to the recipient. A licence grants specific rights to a recipient and may be exclusive or non-exclusive, time bounded and restricted to fields of operation and to geographic territories. An option will grant preferred rights to enable the recipient to reach a decision as to whether it wishes to take a full licence. An assignment passes all rights to the recipient in perpetuity, essentially conferring ownership on the recipient.

Spin-out a new company created from within the HEI which will have a licence from the HEI and/or in which the HEI will hold an equity stake.

Patent application the first filing of a patent application.

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