NISP CONNECT

NICEP
Northern Ireland
Centre for Economic Policy

NORTHERN IRELAND KNOWLEDGE ECONOMY INDEX

A benchmarking report tracking the health of the Northern Ireland Knowledge Economy against other UK regions

2013

OXFORD ECONOMICS

Department of Enterprise, Trade and Investment
www.detini.gov.uk

European Union
European Regional Development Fund
Investing in your future

Report prepared by NICEP for Northern Ireland Science Park CONNECT

Project part financed by the European Regional Development Fund under the European Sustainable Competitiveness Programme for Northern Ireland.

Table of Contents

1 EXECUTIVE SUMMARY

The Knowledge Economy is an important and growing component of the Northern Ireland (NI) economy, within which companies invest in research, development, innovation, creativity and sales & marketing.

This investment allows them to compete internationally with the result that a range of highly skilled and well paid employment opportunities are provided in NI. The most recent data demonstrates that the Knowledge Economy had a successful year, posting growth in fourteen out of the twenty one indicators that make up the Index. This is a laudable performance for the sector in the context of a challenging macroeconomic environment.

Whilst this performance is very much welcomed, the regional rankings show that on average, NI is ranked tenth out of the twelve UK regions. These data serve to underline the scale of the challenge that faces both those who work in the Knowledge Economy and in economic policy in NI, if the sector is to grow to a level where it is equivalent to the UK average.

TABLE 1: SUMMARY OF KNOWLEDGE ECONOMY INDICATORS

Knowledge Economy Core characteristics (CONNECT definition)	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
KE employment, as % of total employment	4.6%	4.8%	9	v	2011	COE/BRES
KE businesses, as % of total business stock	4.0%	4.2%	12	=	2011	IDBR
KE business start ups per 100,000 population*	14	16	12	=	2011	IDBR/ NOMIS
Science and Technology employees average wage level (per week)	£573	£544	12	v	2012	Labour Force Survey

Investment Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
No. of private equity and VC investments (no. of companies)	13	26	12	=	2012	BVCA
No. of private equity investments per 100,000 VAT registered businesses	16	31	6	^^^^	2012	BVCA
No. of venture capital investment per 100,000 VAT registered businesses	12	29	2	^^^^	2012	BVCA
Amount of VC investment, £M	£20	£2	12	vvvvvvv	2012	BVCA
No. of M&A and ECM deals per 100,000 VAT registered businesses	66	89	12	=	2012	Experian Corpfin
Public listed companies: Market capitalisation per head	£169	£251	10*	=	2013	London Stock Exchange*

Note: * London Stock Exchange definition of UK regions includes 10 rather than 12 regions.

R&D Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
R&D as % of workplace based GVA	1.7%	1.7%	7	=	2011	UK R&D Survey
Business Expenditure on R&D as % of workplace GVA	1.1%	1.2%	7	v	2011	UK R&D Survey
R&D personnel as % of total employment	1.0%	1.0%	6	^	2009	Eurostat
No. of PhDs per million inhabitant	263	284	8	^	2011/12	HEIDI
HEI Research grants and contracts per 1,000 population	£45.1	£44.6	9	=	2011/12	HEIDI
No. of science and tech' graduates (NVQ Level 4+) as % of workforce	9.4%	10.5%	11	^	2012	Labour Force Survey

Innovation and Patent Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
% of firms stating that they are innovation active	27.0%	27.0%	11	=	2008-10	DETI UK Innovation Survey
No. of patent applications per million inhabitant (to EPO)	33	11	12	=	2009	OECD
No. of high technology patents per million inhabitant (to EPO)	16	4	12	=	2009	OECD
No. of patent applications filed per million inhabitant (to UK IPO)	138	139	11	^	2012	UK IPO
No. of patents granted per million inhabitant (to UK IPO)	9	13	12	=	2012	UK IPO

Note: ^Represents an increase in regional ranking by one place; = Represents an unchanged regional ranking; and v represents a decrease in regional ranking by one place.

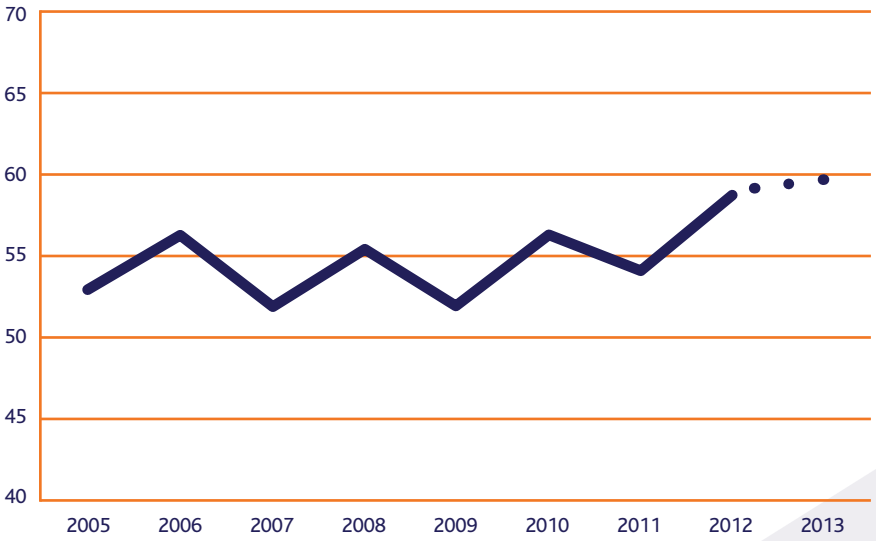
When the elements of the Knowledge Economy Index are considered, the strongest performance is recorded within R&D where NI is ranked, on average, eighth out of the twelve UK regions.

Venture Capital and private equity was the most volatile element of the index over the last year, reducing from £20m (which includes one large deal) to just £2m of investment with a flurry of very small deals resulting in an increase in activity along with a reduction in value.

These factors have resulted in an improvement in the regional rankings in terms of VC activity, but also a significant decline in the regional ranking of eight places to twelfth in terms of value.

The new composite Knowledge Economy Index (KEI) developed by NICEP shows that when measured across all of the indicators, the Knowledge Economy has grown more rapidly in NI than in the UK, especially since the recession.

FIGURE 1: NI COMPOSITE KNOWLEDGE ECONOMY INDEX (UK = 100)



Source: NICEP
Note: 2013 is a forecast

The major driving factors in 2010 and 2011 includes;

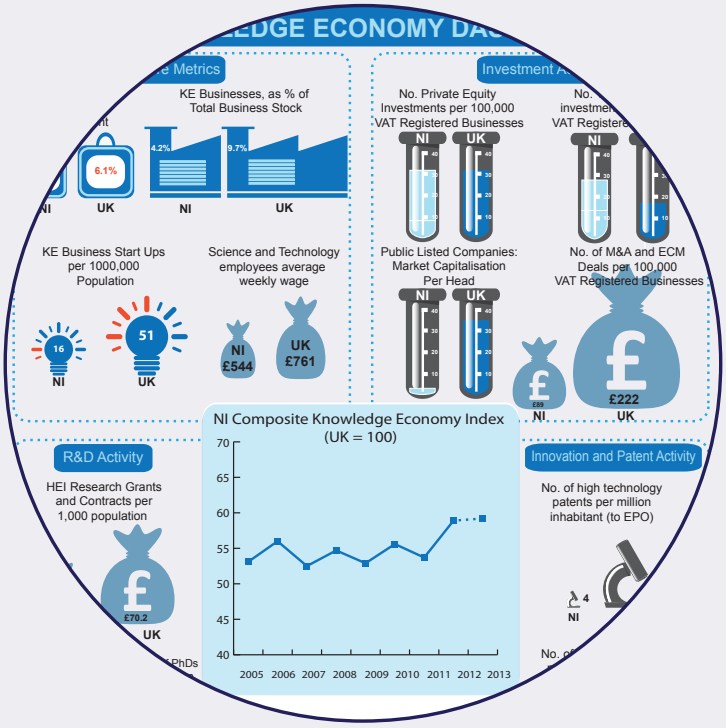
- Business start-ups per 100,000 population;
- Private equity and VC investments per 100,000 VAT registered businesses;
- Market capitalisation of PLCs per head of population; and
- The number of patent applications filed and granted per million inhabitants.

All of which have grown by more than thirty per cent between 2009 and 2012.

Figure 1 shows that the NI Knowledge Economy has been catching up with the UK, albeit growing from a relatively smaller base. NI's relatively strong performance in growth terms is to be welcomed and also underlines the importance of continuing to ensure that the policy environment remains conducive to growth and helps NI to continue closing the gap with the UK.

1.1 DASHBOARD

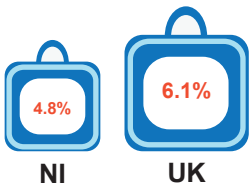
The Knowledge Economy dashboard brings together all of the indicators used in the index and provides a clear and succinct snapshot of the latest available data. The composite index clearly shows the progress made since 2005 and the metrics show the relative position of each indicator.



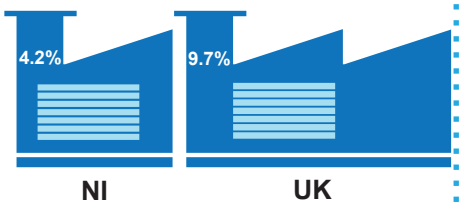
NI KNOWLEDGE ECONOMY DASHBOARD

Core Metrics

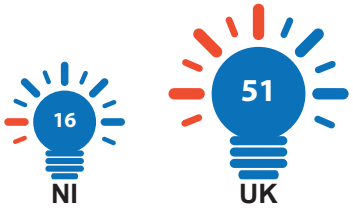
KE Employment, as % of total employment



KE Businesses, as % of Total Business Stock



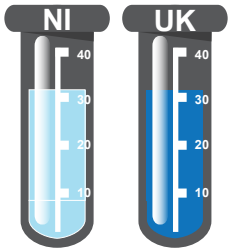
KE Business Start Ups per 1000,000 Population



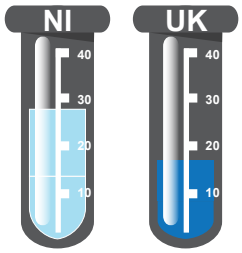
Science and Technology employees average weekly wage

Investment Activity

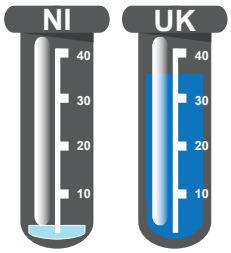
No. Private Equity Investments per 100,000 VAT Registered Businesses



No. Venture Capital investments per 100,000 VAT Registered Businesses

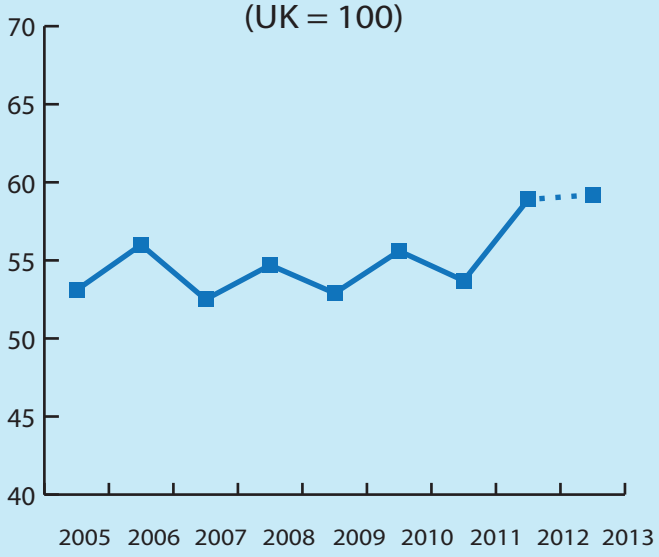


Public Listed Companies: Market Capitalisation Per Head



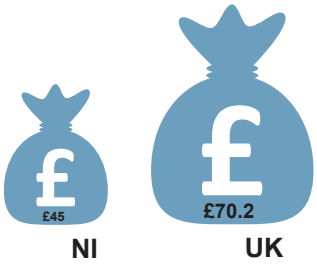
No. of M&A and ECM Deals per 100,000 VAT Registered Businesses

NI Composite Knowledge Economy Index (UK = 100)



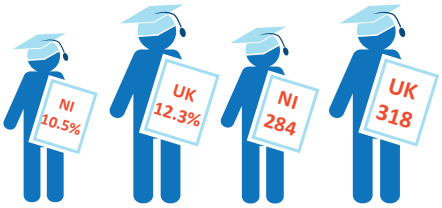
R&D Activity

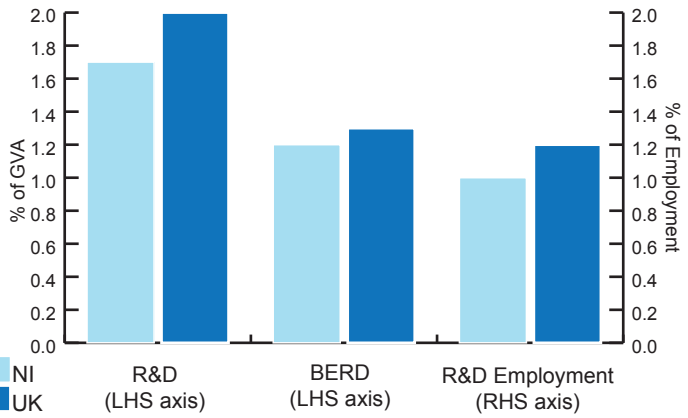
HEI Research Grants and Contracts per 1,000 population



No. of S&T Graduates (NVQ Level 4+) as % of workforce

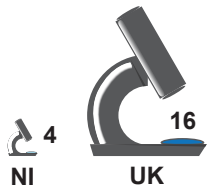
No. of PhDs per million inhabitants



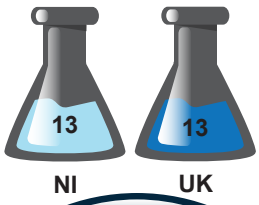


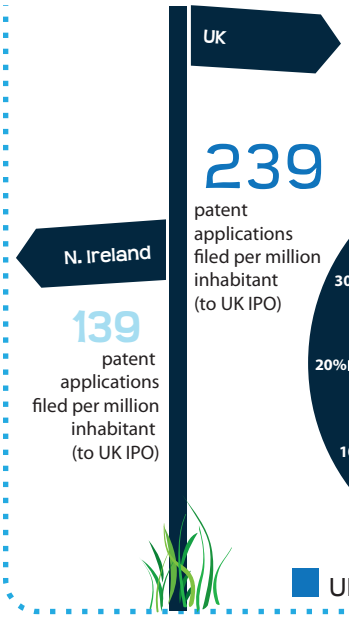
Innovation and Patent Activity

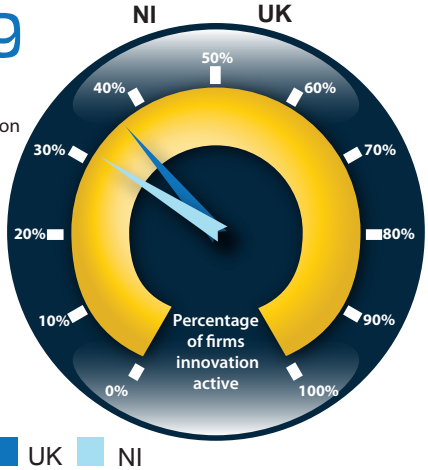
No. of high technology patents per million inhabitant (to EPO)



No. of patents granted per million inhabitant (to UK IPO)







1.2 BUILDING AN EVIDENCE BASE FOR COMPANIES AND POLICY

The study has revealed a number of areas where more timely and open access to data and additional research would be of benefit to NI.

There are issues in terms of the timeliness of official data and also the ability of the research community to access it, which could improve our understanding of the issues on indicators such as Knowledge Economy wages and the seemingly strange reduction in employment in the creative content and digital media sector.

Addressing these recommendations will help in terms of increasing the level of understanding of the sector, filling important gaps in the data and bringing forward additional evidence that will help in the formulation and implementation of policy.

IN TERMS OF ADDITIONAL RESEARCH, THERE ARE FOUR KEY AREAS THAT WE RECOMMEND SHOULD BE TAKEN FORWARD. THEY ARE:

1.2.1 FULL ECONOMIC IMPACT ASSESSMENT

Evidence from San Diego suggests that the multiplier effect of the Knowledge Economy could be higher than the average multiplier for the whole economy, given the relatively high wages and applicability of knowledge across sectors and technologies. This research should be replicated for NI.

1.2.2 VC - NORTH EAST EXEMPLAR AND EAST OF ENGLAND'S ALTERNATIVES

The North East of England has been the most successful UK region, by a significant degree in terms of Venture Capital, whilst the East of England has performed relatively poorly. Additional research should be undertaken in order to understand the driving factors and policy environment that underpin the strong performance in the North East. Also, given the amount of R&D that takes place in the East of England, it would be helpful to understand the alternative financing arrangements available for innovative businesses.

1.2.3 PATENT ACTIVITY AND COMMERCIALISATION

Further research should be conducted into the commercialisation of R&D and innovation activity in NI to establish why;

- The numbers of patent applications and conversions to patents granted are low in NI?
- What policy measures may help? and
- What programmes could be offered or augmented in NI?

1.2.4 MATCHED STUDY WITH SAN DIEGO

Given the genesis of the Connect programme in San Diego, a matched firms study would be particularly valuable for NI in order to understand differences in management practices, behaviours and cultures that are prevalent and how policy may be formed in order to help grow the Knowledge Economy in NI.

1.3 MOVING IN THE RIGHT DIRECTION

Over the past year, the NI Knowledge Economy has made good progress in a number of areas. The newly developed composite Knowledge Economy Index confirms this as NI has continued to catch up with the UK, although from a significantly lower base.

The index provides a new perspective on the overall health of the sector and can be employed as a monitoring tool that could be developed, in partnership with others, into a target metric for measuring the success of innovation oriented strategies.

It is also important that we acknowledge that this is a "dynamic game" in that all UK regions are striving to grow their Knowledge Economies, increase employment, productivity and overall standard of living. Therefore, the NI Knowledge Economy must continue to strive not just to be average, but to be above average and continue to grow more rapidly if it is to deliver on the aspirations set out in earlier reports within this series.

There are a significant number of challenges that NI must overcome on the road to delivering these aspirations.

There are a number of data issues in terms of gaps and lags, and there are several areas where additional research and knowledge will be of benefit in terms of learning from the successes and apparent alternatives that may prevail in other regions. NI can learn from other regions, but must also "know itself" in terms of the data, behaviours and cultures that are at play in the Knowledge Economy in NI.

The Knowledge Economy is a small, vibrant and vital sector of the NI economy, providing highly skilled and well-paid jobs, exporting across the globe and helping to deliver on many of the Programme for Government and Innovation Strategy targets. It must be cultivated, with an accommodative policy environment, support from businesses and trade organisations and most essentially sustained drive from within the sector to succeed.

1.4 ACKNOWLEDGEMENTS

We would like to thank Giulia Montefiore from Durham University, who worked as an intern in NICEP and helped to gather much of the data used in this report. For the case studies, which provide a taste of what companies within the Knowledge Economy are doing, we would like to thank the NI Science Park, Sofia Search, Titan IC, Randox Laboratories and DisplayNote. We would also like to thank Oliver Parsons from Invest NI, for building the Knowledge Economy dashboard.

Lastly, we would like to thank those who were part of the Knowledge Economy Steering Group for their help and insightful comments throughout the process of developing this report.

2 INTRODUCTION AND CONTEXT

2.1 SCOPE OF THIS REPORT

The NI Centre for Economic Policy and Oxford Economics have been commissioned by the Northern Ireland Science Park CONNECT (NISP CONNECT) to update the CONNECT innovation indicators formulated in the 2011 Knowledge Economy Baseline Report.

These indicators were designed to track the health of the Northern Ireland Knowledge Economy on an annual basis against other UK regions. A total of twenty one indicators make up the Knowledge Economy Index under the sub headings of core indicators, investment, R&D and innovation & patent activity.

These indicators form an effective monitoring framework to support the on-going implementation of the NISP CONNECT programme and help to identify the necessary steps that are required to achieve the ambitious goals of the programme.

As part of this three year contract, we will help to develop the NISP CONNECT programme to become an informative and robust source of information on the Knowledge Economy that can be used by those in the sector, policy makers and economic commentators. This year, a composite Knowledge Economy Index has been developed and suggestions are included within this report on areas that would benefit from additional research. Earlier reports from this Knowledge Economy series, authored by Oxford Economics, developed forecasts for the sector and we will return to these in future years to monitor and provide an update on progress.

2.2 CONTEXT

In recent months a number of NI economic indicators have become more positive. Ulster Bank have reported that employment rose at its fastest pace since August 2007 (PMI October 2013) and DETI's labour market statistics publication (November 2013) reports an increase in employment of 11,000 and a decrease in unemployment and economic inactivity of 1,000 and 8,000 respectively over the quarter. There is little doubt that recovery is underway in NI.

However, it will take a number of years for NI to regain the ground lost since the peak of the boom and a number of underlying challenges remain, including high levels of consumer and government debt and limited growth prospects within the Eurozone, at least in the short term. Whilst NI has experienced an improvement in many economic indicators during recent months, it is important to recognise that due to the sometimes significant time lags in publishing economic data, the analysis contained within this report is based on data for 2011 and 2012 in the main, and therefore the economic context of that period is more negative than current conditions.

The ambitions of the NI Science Park and the Knowledge Economy Index align well with the Northern Ireland Executive's priorities contained within the Programme for Government, Economic Strategy and also the draft Innovation Strategy for 2013-2025, recently published by DETI for consultation. The Ministerial foreword from the Innovation Strategy states that;

> **"During challenging global economic conditions the need for innovation is even greater, as it allows firms to stay ahead of their competitors and position themselves to exploit growth during recovery. From the wider economy perspective, the level of innovation in a region is an important factor in attracting inward investment. It is for these reasons that the Northern Ireland Executive has placed innovation at the core of its drive to rebalance the economy"**

[1]For the full report please visit: http://www.nisp.co.uk/?page_id=302

It also states that;

> **"Innovation is one of the primary drivers of economic growth, underpinning the growth of the best performing regional and national economies across the world. Innovation enables firms to stay ahead of competitors, and with global economic conditions remaining challenging, the focus on innovation is now more important than ever."**

The work of NISP CONNECT also complements the work carried out by Matrix, the NI Science Industry Panel and its HORIZON panel as they also strive to help develop the Knowledge Economy in NI. Given that Matrix is all about Science and Technology and its exploitation, they believe that this Index is an essential tool in helping to measure progress in the NI Knowledge Economy. Matrix looks forward to working with NISP CONNECT on future iterations of the KEI.

In summary, while recent economic news for NI has been positive, a number of challenges remain. The NI Executive is committed to the innovation agenda and continuing work of Matrix. Alongside this, the draft NI Innovation Strategy provides an additional perspective and policy impetus, complementing the work of NISP CONNECT.

2.3 STRUCTURE OF THIS REPORT

The remainder of this report is structured as follows:

- **Chapter 3** introduces the new Composite Knowledge Economy Index;
- **Chapter 4** explores the new data (where available) for the CONNECT key innovation metrics in core metrics, investment activity, R&D and research activity and innovation and patent activity and;
- **Chapter 5** summarises the key messages and progress since the 2009 baseline report by Oxford Economics.

2.4 WHAT IS THE KNOWLEDGE ECONOMY?

2.4.1 CONNECT SECTOR DEFINITION

The Knowledge Economy is an aggregation of the following sectors, based on the San Diego CONNECT model, which represents research intensive sectors where new ideas, new products and new processes are key determinants of competitiveness[2]:

A full list of Standard Industrial Classification (SIC) codes used to define the Knowledge Economy is included in Annex A. The sectors align closely with the Matrix defined themes.

- **Pharmaceuticals and biotechnology;**
- **Medical devices;**
- **Software & digital content;**
- **IT services;**
- **Telecommunications;**
- **Computing and advanced electronics;**
- **Creative content and digital media;**
- **Other technical services; and**
- **Aerospace and other transport equipment.**

[2]During challenging global economic conditions the need for innovation is even greater, as it allows firms to stay ahead of their competitors and position themselves to exploit growth during recovery. From the wider economy perspective, the level of innovation in a region is an important factor in attracting inward investment. It is for these reasons that the Northern Ireland Executive has placed innovation at the core of its drive to rebalance the economy

2.5 NISP CONNECT ASPIRATIONAL TRAJECTORY

As part of an earlier report within the Knowledge Economy Index series, Oxford Economics, NISP CONNECT and its stakeholders outlined their vision for the NI Knowledge Economy which puts into context the magnitude of change that will be required if NI is become a world leader in terms of its Knowledge Economy. In line with this vision, aspirational targets for 2030 were developed for all of the innovation metrics. The indicators and targets are detailed in table 2.

TABLE 2: CONNECT INDICATORS & TARGETS

Knowledge Economy Core characteristics (CONNECT definition)	Original 2009	2009	2010	2011	2012	2030 target
Knowledge economy employment, number of employees	30,600	31,409	32,390	33,370	-	71,250
knowledge economy businesses, total no. of businesses	2,100	2,340	2,365	2,415	-	7,000
Knowledge economy business ups (number of companies)	200	225	260	295	-	500
Knowledge economy average wage level - premium	£11,320	£8,427	£7,750	£6,172	-	£25,150

Investment Activity	Original 2009	2009	2010	2011	2012	2030 target
Number of private equity investments (number of companies)	20	14	20	13	26	30
Number of venture capital investments (number of deals)	14	7	14	10	24	30
Number of M&A and ECM activity (number of deals)	32	47	34	38	52	77
VC investment, £million	£12	£2	£5	£20	£2	£90
Number of public listed companies	3	3	3	3	3	24

R&D and Research Activity	Original 2009	2009	2010	2011	2012	2030 target
Total expenditure on R&D, £million	£500	£472	£499	£520	-	£1,050
Total expenditure on Business R&D (BERD), £million	£300	£297	£324	£352	-	£740
R&D personnel, number of employees	6,500	-	-	-	-	15,130
Number of PhDs per annum*	400	225	263	284	-	930
HEI Research grants and contracts, £million*	£80	£50	£49	£45	-	£186
Number of science and technology graduates (NVQ Level 4+)	57,300	76,372	81,423	65,424	73,054	71,250

Innovation and Patent Activity	Original 2009	2009	2010	2011	2012	2030 target
Number of firms stating that they are innovation active	27.0%	27.0%	27.0%	-	-	53.2%
Number of patent applications per million inhabitant (to EPO)	60	11	-	-	-	140
Number of high technology patents per million inhabitant (to EPO)	20	4	-	-	-	50

Source: NICEP & Oxford Economics

With only one year of additional data published since the last KEI report, progress towards the targets has been limited. Therefore, in this report, the focus is on the new and innovative composite Knowledge Economy index which was developed by NICEP in order to assess the overall performance of the sector and provide a comparison with the UK.

This new tool demonstrates clearly the progress that has been made in NI since 2005, but it also underlines the scale of the challenge that NI faces if it is to close the gap with the UK. We will return to these forecasts in future years to monitor and provide an update on progress.

3 THE COMPOSITE KNOWLEDGE ECONOMY INDEX

The new composite Knowledge Economy Index (KEI)[3] is an innovation that will allow the overall progress of the Knowledge Economy to be monitored for NI and the UK, and will also enable reporting of NI's position relative to the UK as a whole. The index will be updated annually and will provide a succinct and easily understood snapshot of the progress of the sector.

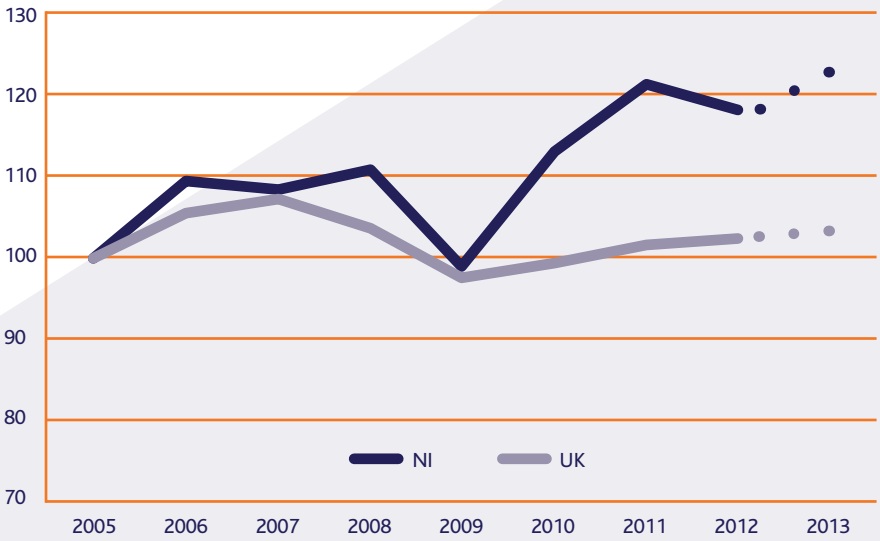
The composite KEI shows that the Knowledge Economy has grown more rapidly in NI than in the UK, especially since the 2008/09 recession and this is depicted in figure 2. The major driving factors in 2010 and 2011 include;

- Business start-ups per 100,000 population;
- Private equity and VC investments per 100,000 VAT registered businesses;
- Market capitalisation of PLCs per head of population; and
- The number of patent applications filed and granted per million inhabitants.

All of which have grown by more than thirty per cent between 2009 and 2012.

Whilst this performance is very much welcomed, it should also be noted that the Knowledge Economy in NI has been growing from a significantly smaller base and, to a large extent, the sector is playing "catch-up" with the UK.

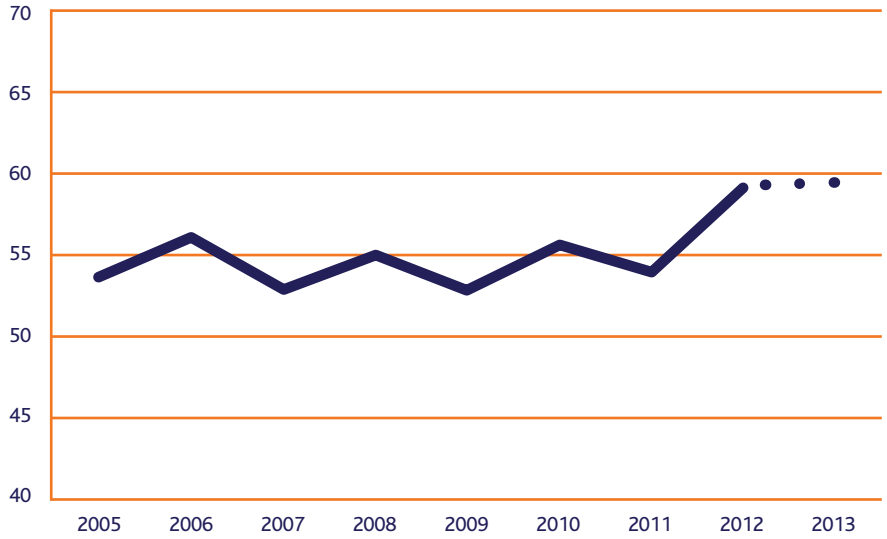
FIGURE 2: COMPOSITE KNOWLEDGE ECONOMY INDICES, UK & NI (2005 = 100)



Source: NICEP
Note: 2013 is a forecast

[3]The Knowledge Economy Index is a composite index in that includes all twenty one of the indicators that are listed in table 1. It is calculated using the weighted average growth rate of each of the indicators from 2005.

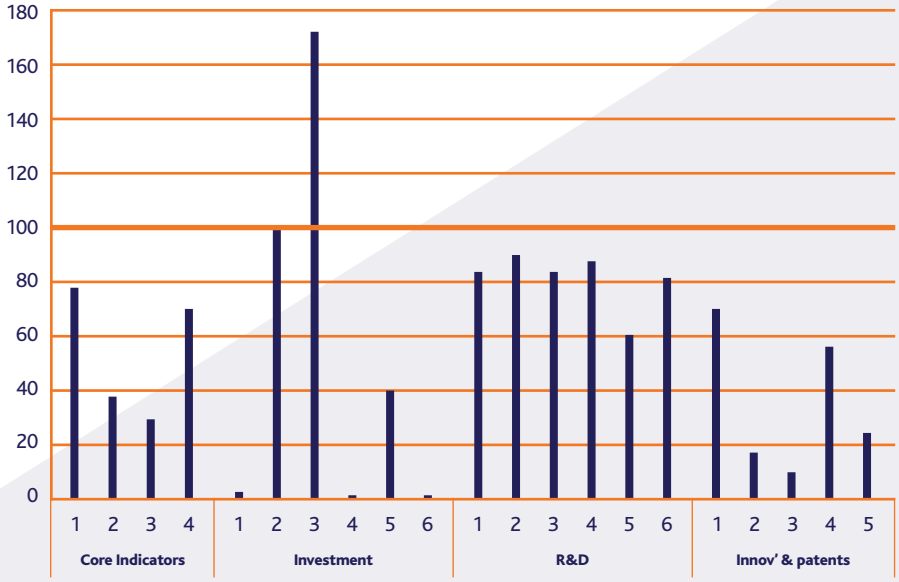
FIGURE 3: NI COMPOSITE KNOWLEDGE ECONOMY INDEX (UK = 100)



Source: NICEP
Note: 2013 is a forecast

Figure 3 shows that in relative terms the NI Knowledge Economy has grown from 53% of the UK to 59% over an eight year period – which is to be commended – but it also underlines the importance of continuing to ensure that the policy environment remains conducive to growth and helps NI to continue closing the gap with the UK.

FIGURE 4: NI KNOWLEDGE ECONOMY INDICATORS, 2012 (UK = 100)



Source: NICEP

Figure 4 shows each of the indicators within the Knowledge Economy Index, presented relative to the UK. It is particularly noteworthy that only one indicator (number of VC investments per 100,000 businesses) is relatively higher than the UK average (29 in NI compared to 17 in the UK). This is primarily due to a flurry a small VC investments in NI, combined with a relatively smaller business base.

4 KNOWLEDGE ECONOMY – UPDATE ON METRICS

4.1 INTRODUCTION

This chapter of the report provides an update on the Knowledge Economy metrics and also includes a number of case studies that provide a taste of the types of activity that the companies in this sector are engaged in, their level of sophistication and significant global reach.

This chapter reports on the performance of the NI Knowledge Economy metrics contained within the four activity areas. They are;

- **Core metrics;**
- **Investment activity;**
- **R&D activity; and**
- **Innovation and patent activity.**

The CONNECT sector definition of the Knowledge Economy, as previously discussed and outlined in Annex A, is based on 2007 Standard Industrial Classification (SIC) codes at 5 digit level.

4.2 CORE METRICS

4.2.1 SOLID EMPLOYMENT GROWTH

Employment in the Knowledge Economy grew by 6.2% between 2009 and 2011, which is impressive in that this is almost two and a half times faster than in the UK over the same period and is set against an overall contraction in workforce jobs in NI of 1.8% over the same period.

When considered as a proportion of total employment, the Knowledge Economy now makes up 4.8% of total employment compared to 6.1% in the UK, and whilst the differential with the UK has been narrowing, the proportion remains lower.

When the sectoral patterns are examined, six out of the nine sectors within the Knowledge Economy grew more rapidly in NI than they did in the UK (highlighted in green in table 3). It is also noteworthy that four out of the nine sectors within the Knowledge Economy (pharmaceuticals & biotechnology, software, communications and other technical consultancy) posted double digit growth from 2009 to the 2011, which is the latest available data, which is impressive given macroeconomic conditions during that period.

TABLE 3: EMPLOYMENT IN THE KNOWLEDGE ECONOMY (CONNECT DEFINITION), 2009 AND 2011

	Northern Ireland			UK		
	2009	2011	% change	2009	2011	% change
Aerospace and other transport equipment	9,711	9,919	2.1%	316,777	299,483	-5.5%
Software	5,033	5,581	10.9%	109,705	131,999	20.3%
Computing and advanced electronics	4,792	5,206	8.6%	67,715	70,238	3.7%
Medical devices	3,846	4,015	4.4%	206,119	206,578	0.2%
IT services	2,724	2,992	9.8%	424,207	452,002	6.6%
Pharmaceuticals and biotechnology	1,585	1,870	18.0%	41,094	49,564	20.6%
Communications	1,385	1,555	12.3%	212,501	197,975	-6.8%
Other technical consultancy	1,622	1,819	12.1%	181,314	188,421	3.9%
Creative content and digital media	711	413	-41.9%	68,985	72,470	5.1%
Knowledge Economy	**31,409**	**33,370**	**6.2%**	**1,628,417**	**1,668,730**	**2.5%**

Source: Business Register and Employment survey (BRES) and Census of Employment.
Note: 2011 is the latest available data

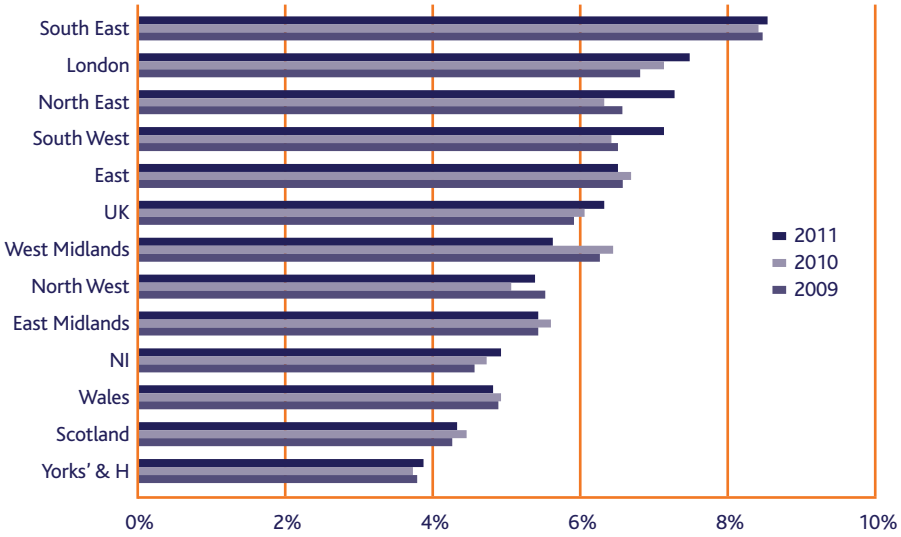
If the data are correct, one sector that does give cause for concern is creative content and digital media, which has contracted by almost 42 per cent, according to the DETI Census of Employment. Later in the report, we will see that the number of businesses in the creative content and digital media sector has increased by 2.4% over the same period, which does not align well with the employment figures for that period. This specific issue is worthy of further investigation, but would require access to individual company information in order to better understand the underlying issues and trends.

NI's relatively strong performance can be seen in figure 5 in the context of the other UK regions and over the last year, NI improved its regional ranking by one place to ninth (out of the twelve UK regions), moving ahead of Wales. The south eastern corner of England is above the UK average, as would be expected, but interestingly, the North East, which is in many ways comparable to NI ranks third.

Data for the Knowledge Economy is often dated and a number of surveys (such as the Annual Survey of Hours and Earnings) cannot provide data for the sector, due to small sample sizes for NI. When required, data should be aggregated to ensure that issues around disclosure are addressed.

Given the importance of this sector for economic development, it is essential that accurate and up to date information forms the base for analysis and building subsequent policy recommendations. This issue should be explored further with NISRA / DFP.

FIGURE 5: EMPLOYMENT IN THE KNOWLEDGE ECONOMY AS A % OF TOTAL EMPLOYMENT, 2009 – 2011



Source: Business Register and Employment survey (BRES) and Census of Employment.
Note: 2010 data estimated for NI as Census of Employment reports only on 2009 and 2011.

In summary, the NI Knowledge Economy has posted a solid performance in terms of employment growth and has improved its regional ranking by one place. This is an impressive performance at both an overall and sectoral level, but challenges remain if the NI Knowledge Economy is to grow to the same size as its UK counterpart. To give an indication of the magnitude of change that would be required to get to the UK level,

NI would need to create an additional nine thousand Knowledge Economy jobs just to equal the UK as a proportion of total employment.

SUPPLY CHAIN AND DOWNSTREAM EFFECTS

This research focuses on the direct economic impact of the Knowledge Economy in NI. In terms of modelling the overall economic impact of the sector in NI, it is important to also consider the downstream effects of the activity that takes place within the sector. This could be done by using supply chain data for companies (if it were to be made available) or using input output tables. However, input output tables are not publicly available for NI at this point in time and the closest available alternative are the Scottish tables. In addition, research carried out in San Diego found that the overall employment multiplier for the Knowledge Economy was 2.6, which is higher than an "all economy average" employment multiplier.

Therefore, it is recommended that additional research is carried out to calculate the indirect, induced and overall employment and output multipliers for the sector, which can then be used to augment the KEI research in the future.

4.2.2 SMALL, BUT GROWING NUMBERS OF BUSINESSES

The number of businesses within the Knowledge Economy has grown by 3.2% from 2009 to 2011, whilst the total stock of businesses in NI has fallen by 3.9% as difficult macroeconomic conditions prevailed during that period. These data underscore the resilience of the Knowledge Economy, particularly as many of these businesses are outward looking and competing in high quality markets with intelligent, sophisticated and differentiated products.

Medical devices, IT services and other technical consultancy have driven the growth in the sector, with only aerospace and transport contracting in terms of business numbers. Whilst the total number of businesses in the aerospace and transport sector has declined, the total number of employees has increased slightly, by 2.1% (see table 4).

TABLE 4: NI KNOWLEDGE ECONOMY BUSINESS STOCKS – CONNECT SECTORS

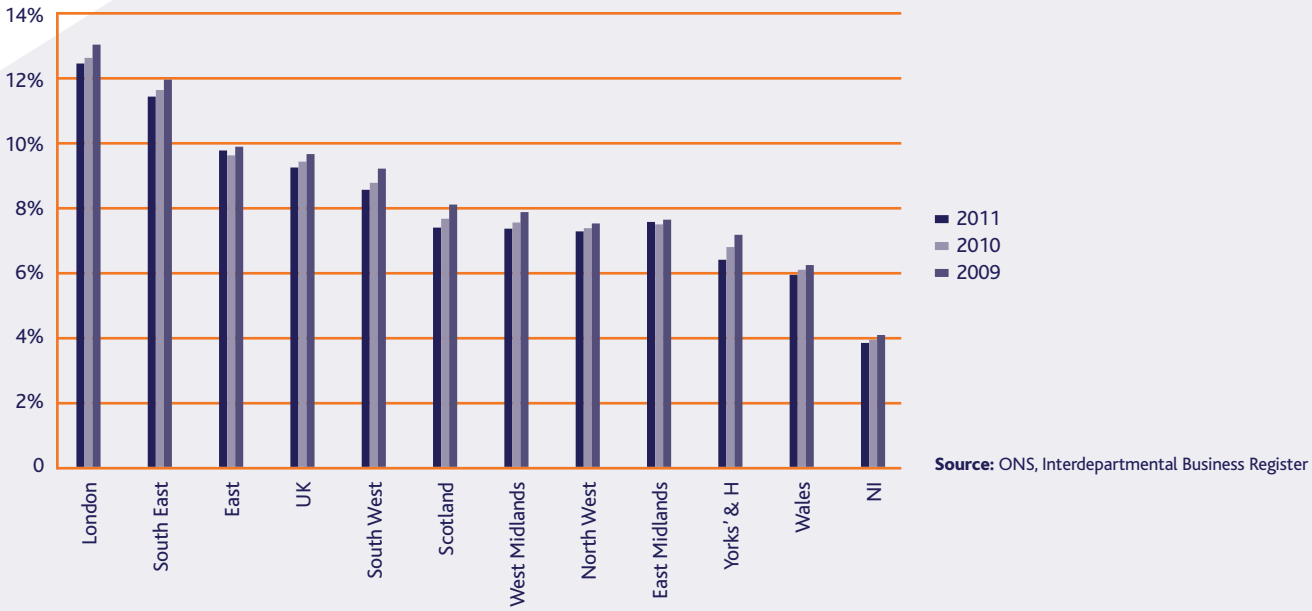
	2009	2010	2011	% change (2009 - 11)	% of total KE (2011)
Aerospace & transport	220	215	190	-13.6%	7.9%
Communications	95	90	100	5.3%	4.1%
Computing	60	65	60	0.0%	2.5%
Creative content	205	195	210	2.4%	8.7%
IT services	470	485	500	6.4%	20.7%
Medical devices	145	155	155	6.9%	6.4%
Other tech consultancy	660	670	700	6.1%	29.0%
Pharma / biotech	15	15	15	0.0%	0.6%
Software	470	475	485	3.2%	20.1%
Total knowledge economy	**2,340**	**2,365**	**2,415**	**3.2%**	**100.0%**
Total active businesses	**59,700**	**58,985**	**57,370**	**-3.9%**	**-**
Knowledge economy total as a % of business stock	**3.9%**	**4.0%**	**4.2%**	**-**	**-**

Source: ONS, Interdepartmental Business Register

The proportion of firms that are in the Knowledge Economy has increased from 3.9% of total business stocks in 2009 to 4.2% in 2011. The relatively large proportionate increase is due to the combined influence of an increase in the number of Knowledge Economy businesses and the decline in total number of businesses in NI. Despite the fact that NI has experienced relatively strong growth, when considered relative to the other UK regions, NI still lags behind the other regions in 12th place. For context,

NI had 2,145 Knowledge Economy businesses in 2011 and would need an additional 3,150 businesses in order to match the UK proportion.

FIGURE 6: KNOWLEDGE ECONOMY BUSINESS STOCKS AS A PROPORTION OF TOTAL REGIONAL BUSINESS STOCKS



Source: ONS, Interdepartmental Business Register

4.2.3 HIGHER NUMBERS OF KE START-UPS

Perhaps the most important of the Knowledge Economy indicators and one of the key indicators from the San Diego CONNECT programme, the number of business births has grown from 225 in 2009, to 295 in 2011. This is a respectable increase of more than thirty per cent, is the fourth fastest rate of growth of the UK regions (2009-11) and only slightly lower than the UK rate, as shown in table 5. Over the same period, total business births declined by 5.1% in NI, which again demonstrates just how resilient the sector is in the face of a recessionary environment during that period.

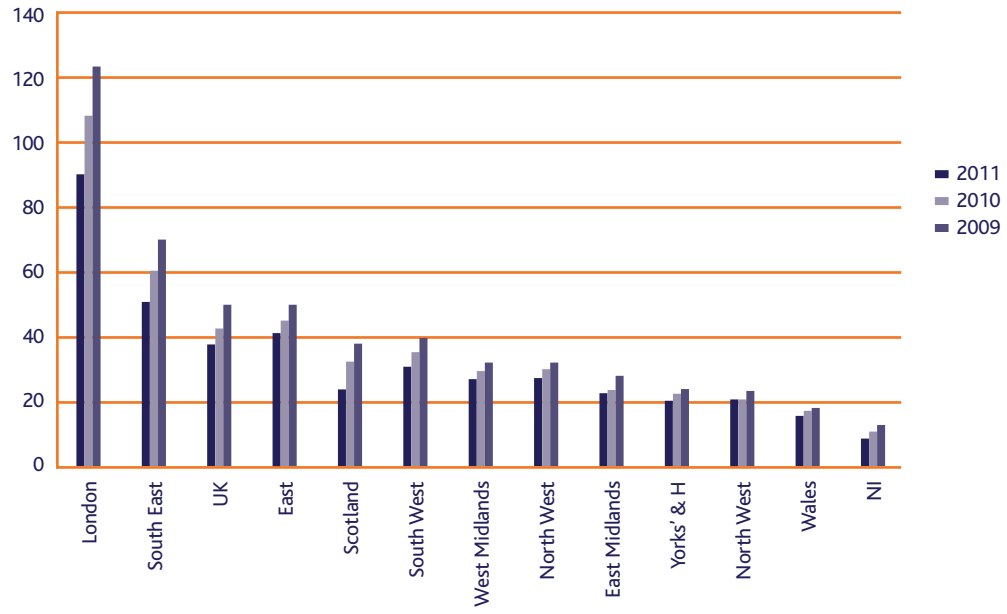
TABLE 5: NI KNOWLEDGE ECONOMY BUSINESS STARTS, 2009 – 11

	2009	2010	2011	% change (09-11)
Scotland	1,370	1,840	2,165	58.0%
London	7,020	8,725	10,250	46.0%
UK	**24,385**	**28,205**	**32,430**	**33.0%**
South East	4,555	5,285	6,040	32.6%
Northern Ireland	**225**	**260**	**295**	**31.1%**
West Midlands	1,530	1,625	2,005	31.0%
South West	1,710	1,925	2,170	26.9%
North West	1,970	2,170	2,445	24.1%
East Midlands	1,120	1,180	1,345	20.1%
East	2,495	2,660	2,965	18.8%
North East	585	590	695	18.8%
Yorkshire & Humber	1,250	1,370	1,430	14.4%
Wales	555	580	625	12.6%

Source: ONS, Interdepartmental Business Register (business start) & NOMIS (population).

Despite this success from an NI perspective, which quite correctly should be acknowledged, the absolute number of business starts is still relatively low in NI and when the figures are standardised in terms of business starts per 100,000 population, NI is still ranked 12th of the UK regions. To put this into context, the Knowledge Economy business birth rate in NI would need to more than treble, from 295 to 922 births per annum in order to post a performance that is equal to the UK. The South Eastern corner of England (which includes London, South East and East) is again, the most productive in terms of Knowledge Economy start-ups and drives the UK average to a significant degree. However, it should also be noted that these figures are workplace based and therefore London will always appear very high because of the high levels of business activity and in commuting to the city.

FIGURE 7: KNOWLEDGE ECONOMY BUSINESS START-UPS PER 100,000 POPULATION



Source: ONS, Interdepartmental Business Register (business starts) & NOMIS (population)

4.2.4 HIGH WAGES

Wage data for the Knowledge Economy has been sourced from the Labour Force Survey as statisticians advised that the data for the sector from the official wages survey (the Annual Survey of Hours and Earnings) could not be released due to small sample sizes.

Whilst this is not the preferred source of wage data, the LFS does reveal that the Knowledge Economy provides relatively highly paid employment across the UK, and NI is no exception with an average weekly wage of £544, which is more than a quarter higher than the NI average weekly wage of £425. The average Knowledge Economy wage in NI is however, the lowest of the UK regions, at 71.5% of the UK Knowledge Economy average.

In terms of its overall impact, the Knowledge Economy in NI employs 4.8% of employees, but pays 6.1% of the total amount of wages in NI.

TABLE 6: AVERAGE WEEKLY GROSS WAGE IN THE KNOWLEDGE ECONOMY, 2012

	KE average weekly wage	All economy average weekly wage	Wage premium	% change (09-11)
London	£949	£631	50.3%	58.0%
East	£794	£511	55.6%	46.0%
South East	£787	£556	41.7%	33.0%
South West	£764	£449	70.2%	32.6%
United Kingdom	**£761**	**£490**	**55.1%**	**31.1%**
East Midlands	£731	£458	59.7%	31.0%
West Midlands	£710	£448	58.5%	26.9%
North West	£687	£450	52.7%	24.1%
Wales	£684	£426	60.7%	20.1%
Scotland	£645	£472	36.7%	18.8%
North East	£640	£436	47.0%	18.8%
Yorkshire & Humber	£631	£442	42.9%	14.4%
Northern Ireland	**£544**	**£425**	**27.9%**	**12.6%**

Source: Labour Force Survey and Annual Survey of Hours and Earnings.

4.2.5 CORE METRICS SUMMARY

The Knowledge Economy in NI has been successful in terms of growth in all of the core metrics since the baseline of 2009, as during a period when macroeconomic conditions created an often difficult trading environment; new businesses have started, employment has increased and wages remain high relative to the rest of the economy.

However, in this dynamic game, the other regions of the UK have also experienced growth with the result that the UK regional picture remains largely unchanged, with NI ranked twelfth in three out of four of the core metrics. The challenge for NI is to emulate the UK, but we must also acknowledge that the UK figures are skewed by the success of the greater south eastern area of England.

TABLE 7: KNOWLEDGE ECONOMY – CORE METRICS

Key indicators for the Knowledge Economy	Baseline position NI (2009)	Current position		Regional ranking NI	Latest data
		NI	UK		
Employment as a % of total employment	4.4%	4.8%	6.1%	9	2011
Businesses as a % of total business stock	3.9%	4.2%	9.7%	12	2011
Business start-ups per 100,000 population	13	16	51	12	2011
Average weekly wage level	£514	£544	£761	12	2012

Source: Individual indicator data sources listed above.
Notes: Regional ranking: 1 = highest, 12 = lowest

CASE STUDY - TITAN IC SYSTEMS: FILTERING CONTENT FASTER FOR THE WORLD'S BIG DATA NEEDS

When a small Northern Ireland company's first customers for its technology are the multimillion dollar tech companies in Silicon Valley you know that something special is happening in this small but innovative company. Titan IC Systems is a spin-out from Queen's University that sits within the community of knowledge workers at the Northern Ireland Science Park. From there, US-based deals are being made with some of the world's biggest companies.

What makes Titan IC unique is that it has developed a cheaper and faster solution for our growing demand for data. Typically the job of filtering internet traffic for malware and analysing big data sets is performed by racks of servers and software, while Titan IC has created a hardware solution specifically customised to do the same thing using less money and energy. As more systems and devices are connected to each other via the internet, and the global hunger for data and content continues to grow, the world needs more powerful tools for the inspection and management of all that traffic. The value of a tool like Titan IC's is that it's fast, really fast. One Titan IC board will process 40Gb/s of data in real-time. That's easily enough to filter all the content coming into a city like Belfast. The same level of processing usually requires the commitment of four or five racks of servers running dedicated software.

From domestic internet consumers streaming videos into their living rooms, to data scientists handling big analytical problems, the need for high-speed traffic filtering is pervasive. The team now hopes to grow the company to many millions in annual revenue by providing a custom solution, configuring each board to the customer's specific needs. But the aim beyond that is to grow Titan IC into a core processor, sitting alongside Intel and ARM cores, bundled in the factory into standard chips, to sit in the inner workings of any connected device in the world.

Source: NI Science Park and Titan IC

4.3 INVESTMENT ACTIVITY

4.3.1 VENTURE CAPITAL – MORE ACTIVITY, BUT LOW VALUES

The venture capital and private equity element of the KEI is, this year, one of the most interesting elements of this report. The reason is that there were a number of relatively small investments, which when standardised by the number of VAT registered businesses meant that, in activity terms, NI was second only to the North East of England. The North East of England is in itself interesting for the Knowledge Economy and policy in NI, in that its performance on the standardised metrics for Venture Capital is more than treble that of the next best performing UK region.

The relatively poor performance of the East of England region is also of interest given that it is home to Cambridge University and the "silicon fen" cluster. It is also the most R&D intensive region of the UK (R&D as a % of GVA is 4.1% and BERD is 3.2%), which begs the question – how are the start-ups, spin-offs and R&D oriented companies financing their investments if they are not using as much venture capital and private equity as other regions?

WE NEED TO LEARN FROM OTHER UK REGIONS

The North East of England has been the most successful UK region in terms of the standardised investment activity measures by a significant degree (companies invested in per 100,000 VAT registered businesses and VC investments per VAT registered 100,000 businesses). This performance is of note given that the North East is normally a lagging region across a range of other economic indicators.

The East of England has performed relatively poorly in terms of VC and private equity, and first impressions suggest that this is counterintuitive given the R&D intensity that exists there.

It is recommended that additional research, and if required, field visits to gather qualitative information are undertaken in order to understand the driving factors and policy environment that underpin the strong performance in the North East and also the financing arrangements that are available for innovative businesses in the East of England.

TABLE 8: PRIVATE EQUITY AND VENTURE CAPITAL INVESTMENTS, 2012

	No. of private equity investments, No. of companies	Companies invested in per 100,000 VAT reg businesses	No. of VC investments per 100,000 VAT reg businesses
North East	82	108	106
NI	**26**	**31**	**29**
Wales	37	33	21
London	191	54	19
UK	**820**	**31**	**17**
West Midlands	77	37	16
Scotland	67	34	16
South East	115	29	15
East Midlands	32	18	12
North West	66	26	11
Yorkshire & Humber	39	27	9
East	39	15	8
South West	49	120	5

Source: British Venture Capital Association (BVCA) **Notes:** Top two regions shaded green and bottom two regions shaded red

4.3.2 VENTURE CAPITAL DOMINATES THE PRIVATE EQUITY MARKET

Examining the sources of private equity in NI reveals that the vast majority came from venture capital, compared to just under half of all investments in the UK. There was a relatively low level of expansion investment activity in NI and no replacement capital or MBO / MBI activity.

TABLE 9: PRIVATE EQUITY INVESTMENT BY TYPE, 2012

	UK		NI	
	No. of companies	% of total	No. of companies	% of total
Venture Capital	431	49.4%	24	85.7%
Expansion	296	33.9%	3	10.7%
Replacement Capital	44	5.0%	0	0.0%
MBO / MBI	100	11.5%	0	0.0%
Other stage	1	0.1%	1	3.6%
Total	**872**	**100.0%**	**28**	**100.0%**

Source: BVCA

VENTURE CAPITAL DATA ISSUES

As raised in the 2012 Knowledge Economy Index report, authored by Oxford Economics, there are numerous difficulties with data on investment activity in Northern Ireland and there is no single source that captures and reports on all venture capital activity. The BVCA data used within this report does not include investments made by ROI or USA based venture capital funds and investments made by local providers that are not members (e.g. Crescent Capital). Another key data constraint is that BVCA data does not cover VC regional investment by detailed stages, i.e. the Seed stage (the most risky), the Start-up stage and later stages (including the Bridge/pre-public stage). In Northern Ireland it is largely perceived that the key issue preventing investment in emerging ideas or products is the shortage of seed funding.

If more detailed data is to be developed then the business community and NISP CONNECT stakeholders need to come together to develop at least an annual data series recording VC investments, perhaps building on existing BVCA datasets.

4.3.3 MERGER AND ACQUISITION RATES INCREASE

The number and value of mergers and acquisitions (M&A) in NI are still the lowest of the UK regions by a significant degree despite the fact that the value of M&As has increased by more than 200% and activity grew by more than a third over the year to 2012. As would be expected, given headquarters effects and M&A activity co-locating with financial centres, London is the most successful of the UK regions with just under a third of activity and more than half of the UK total value of M&As recorded there. Interestingly, in this indicator, the South East and East Anglian regions are below the UK average and the North East and North West are above, which is not normally the case in the UK.

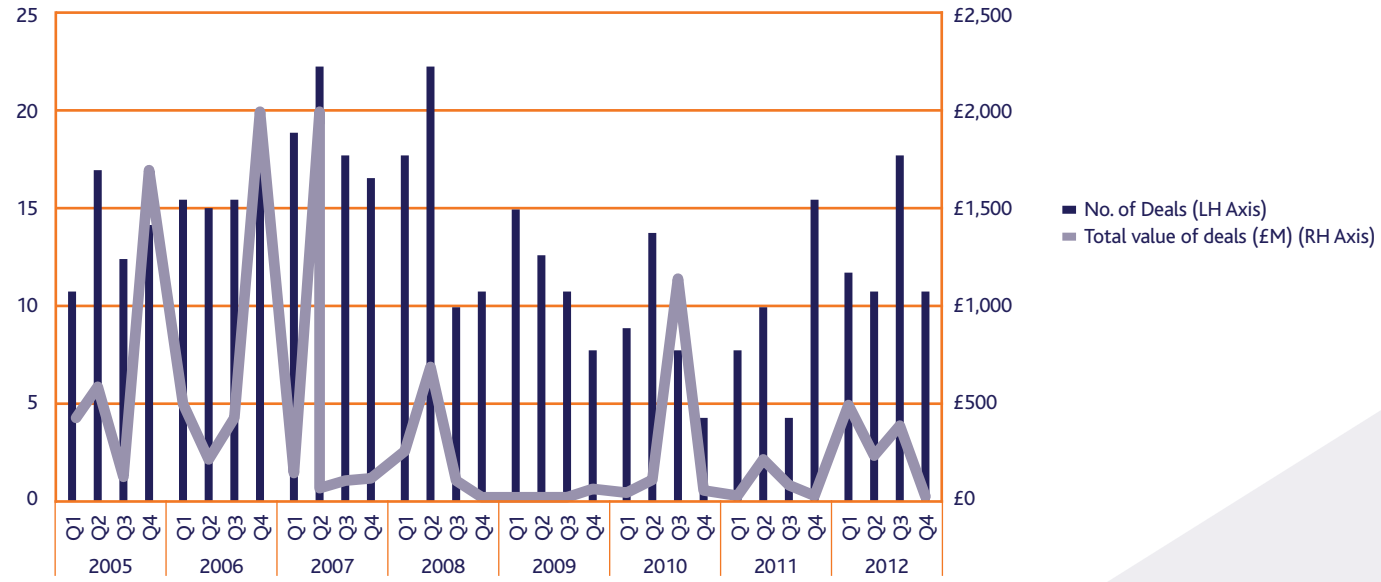
When the data is standardised by the number of M&As per 100,000 VAT registered businesses, Northern Ireland is the lowest with only 66 in 2011 and 89 in 2012. However, figure 8 shows that the volume and value of M&A activity has begun to improve in NI during 2012 and is at its healthiest level since the recession in 2008.

TABLE 10: MERGERS AND ACQUISITIONS BY REGION: VALUE, VOLUME AND VOLUME PER 100,000 VAT REGISTERED BUSINESSES, 2011 AND 2012

	Value (£M)			Volume			M&A activity per 100,000 VAT	
	2011	2012	% change	2011	2012	% change	2011	2012
London	£127,665	£173,076	35.6%	1,707	1,511	-11.5%	405	351
South West	£30,392	£53,221	75.1%	597	641	7.4%	291	310
North West	£10,958	£8,956	-18.3%	658	618	-6.1%	284	264
Scotland	£14,030	£18,391	31.1%	363	401	10.5%	233	253
North East	£7,966	£1,074	-86.5%	155	143	-7.7%	246	224
United Kingdom	**£255,369**	**£308,642**	**20.9%**	**5,572**	**5,272**	**-5.4%**	**238**	**222**
Yorkshire	£2,527	£2,497	-1.2%	334	323	-3.3%	203	195
South East	£36,750	£25,713	-30.0%	690	650	-5.8%	183	171
Midlands	£10,616	£17,784	67.5%	633	583	-7.9%	185	169
Wales	£2,564	£2,946	14.9%	154	136	-11.7%	174	153
East Anglia	£11,517	£3,814	-66.9%	243	214	-11.9%	103	90
Northern Ireland	**£384**	**£1,170**	**204.7%**	**38**	**52**	**36.8%**	**66**	**89**

Source: Experian Corpfin (value and volume), Vat registered business stock from IDBR
Note: Business stock data is provided for Government Office Regions. Experian Corpfin data is presented using Standard Statistical regions and NICEP have estimated business stock figures for the SSRs to calculate M&A activity per 100,000 businesses.

FIGURE 8: NORTHERN IRELAND MERGER AND ACQUISITION ACTIVITY, NUMBER OF DEALS AND VALUE (£M)



Source: Experian Corpfin

4.3.4 LOW NUMBERS OF PUBLIC LISTED COMPANIES (PLCS) IN NI

With only five listed companies and relatively low market capitalisation per head, NI lags significantly behind the UK average. The market capitalisation has grown by almost 50% over the year; however, it is still less than a fifth of the value of Wales, which is the next lowest region. The companies that are listed are Andor Technology, Capital Gearing Trust, First Derivatives, Galleon holdings and UTV Media PLC. The number of listed companies as a proportion of VAT registered businesses (0.01%) does not compare favourably to the UK (0.07%).

TABLE 11: PUBLICLY LISTED COMPANIES, BY UK REGION, 2012 AND 2013

	2012		2013	
	No. of companies	Market capitalisation per head	No. of companies	Market capitalisation per head
London	656	£157,561	841	£187,984
United Kingdom	**1924**	**£29,108**	**1708**	**£34,371**
South East	135	£22,502	146	£26,154
Scotland	82	£14,522	118	£17,776
North West	71	£1,480	100	£11,186
East Anglia	101	£7,929	127	£10,404
South West	98	£7,728	68	£9,867
North East	85	£5,485	89	£6,731
Midlands	58	£2,954	87	£4,999
Wales	9	£1,532	10	£1,464
Northern Ireland	**5**	**£169**	**5**	**£251**
UK incorporated, but NEC	624		117	

Source: London Stock Exchange
Note: Top two regions shaded green and bottom two regions shaded red. Population data is provided on using Government Office Regions. LSE data is presented using Standard Statistical regions and NICEP have estimated business stock figures for the SSRs to calculate market capitalisation per head.

4.3.5 INVESTMENT ACTIVITY SUMMARY

2012 has been an interesting year in the context of the investment indicators for the Knowledge Economy Index in that a flurry of relatively small deals, rather than a small number of larger deals has resulted in significant changes in the regional rankings. In terms of the number of private equity and VC investments per 100,000 businesses, NI has increased its regional ranking by four places since 2011. However, the total value of VC investments has fallen from £20m in 2011 to just £2m in 2012, with the result that NI has fallen eight places from fourth to twelfth. That said however, the average amount of VC investment per annum in NI was £3.9m, excluding 2011, which includes a single large deal and is therefore an outlier from the rest of the data series. Worryingly, the value of VC investments in 2012 was equal to the low point in 2009, which was obviously in the teeth of the financial crisis.

TABLE 12: SUMMARY OF INVESTMENT ACTIVITY INDICATORS

Investment Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
No. of private equity and VC investments (no. of companies)	13	26	12	=	2012	UK R&D Survey
No. of private equity inv' per 100,000 VAT registered businesses	16	31	6	^^^^	2012	UK R&D Survey
No. of venture capital inv' per 100,000 VAT registered businesses	12	29	2	^^^^	2012	Eurostat
Amount of VC investment, £M	£20	£2	12	vvvvvvv	2012	HEIDI
No. of M&A and ECM deals per 100,000 VAT registered businesses	66	89	12	=	2012	HEIDI
Public listed companies: Market capitalisation per head	£169	£251	10*	=	2013	Labour Force Survey

VENTURE CAPITAL

The issues surrounding the demand for and supply of Venture Capital in NI continues to generate substantial debate. The Economic Advisory Group have commissioned research into access to finance in NI and this important piece of research will bring forward more evidence that will help inform the policy debate.

It is essential that the sources of growth finance are mapped out for firms in NI and that policy makers and those in an implementation role fully understand the implications of new policies and programmes on existing provisions, which includes both the private sector financial institutions and other public sector programmes. It is recommended that a holistic overview and joined up policy approach is taken in this arena, perhaps with financial market specialisms in an existing or bespoke Government Finance body.

CASE STUDY – SOPHIA SEARCH

Established in 2007, Sophia is the innovation leader in semantic content analysis. Sophia specialises in automatically extracting precise meaning from content to intuitively understand what it is about without the need for training or human guidance. Sophia is headquartered in San Jose, Calif. with offices in Belfast and St. Petersburg. Sophia's products are unique in providing understanding and context within large sets of unstructured content. According to International Data Corporation the global analytics market will continue to grow at 9.8% annually through to 2016 to reach $50.7 billion. Sophia is well positioned to capitalize on the burgeoning market opportunity with a next-generation semantic analysis solution that leapfrogs traditional analytic search tools.

It is chaired by industry veteran Chris Horn and closed a $3.7 million Series A funding round in March 2013. The investment was led by Atlantic Bridge, and will be used to increase marketing in North America and the UK and to accelerate product roll-out at its development facility at the Northern Ireland Science Park. This financing round represents one of the largest venture investments in a Northern Ireland company in recent times.

Sophia's solution is used in some of the world's largest advertising and publishing houses to automatically understand the meaning of content users are consuming and to intelligently leverage this insight to deliver the information and services they need. Advertisers can achieve up to three times higher click through rates by providing more relevant ad content without using cookies. Publishers' sales can be increased by intelligently recommending titles through an understanding of readers' interests whilst maintaining anonymity.

For more information on Sophia's technology, see: http://sophiasearch.com/technology

Source: NI Science Park and Sophia Search

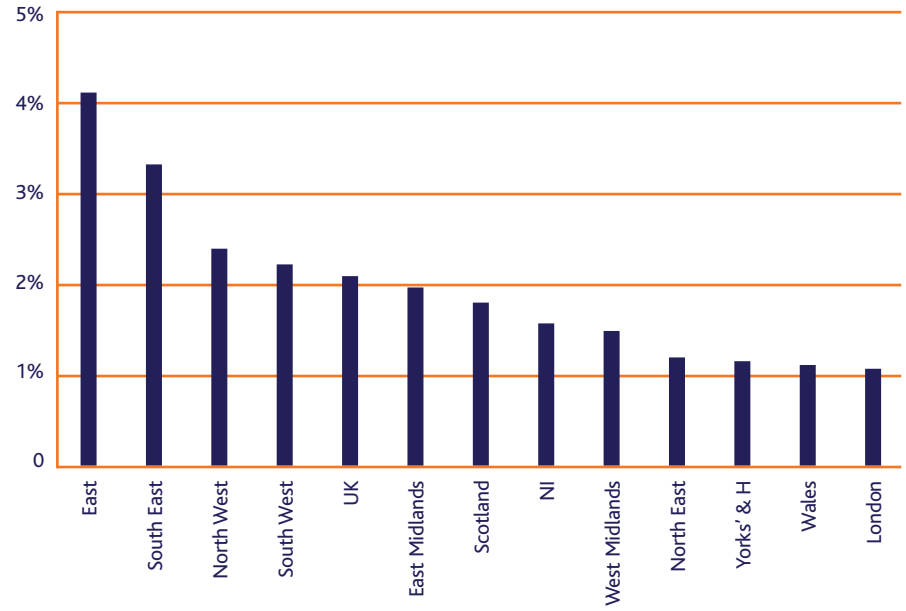
4.4 RESEARCH AND DEVELOPMENT ACTIVITY

The value of R&D activity within an economy is a key driver of productivity and longer term economic growth. As such, the UK's Science and Innovation Investment Framework sets out the UK Governments ambition of increasing expenditure on R&D to 2.5% of GDP by 2014. In 2011. With the UK figure at 2.0%, there remains a significant challenge if the UK is to deliver against its ambition. Within the R&D activity element of the KEI, Northern Ireland has performed well, ranking on average, eighth of the UK regions across the six indicators contained within this element.

4.4.1 TOTAL R&D LEVELS SUSTAINED

NI has performed reasonably well in terms of R&D as a proportion of GVA, ranked seventh of the UK regions, maintaining it R&D level at 1.7% of GVA for the third year in a row. This is significant in that R&D as a proportion of GVA hovered at around 1.2% from 2006 -08. It then stepped up to 1.7% in 2009 and this figure has been maintained in 2010 and 11.

FIGURE 9: R&D AS A % OF WORKPLACE GVA, 2011



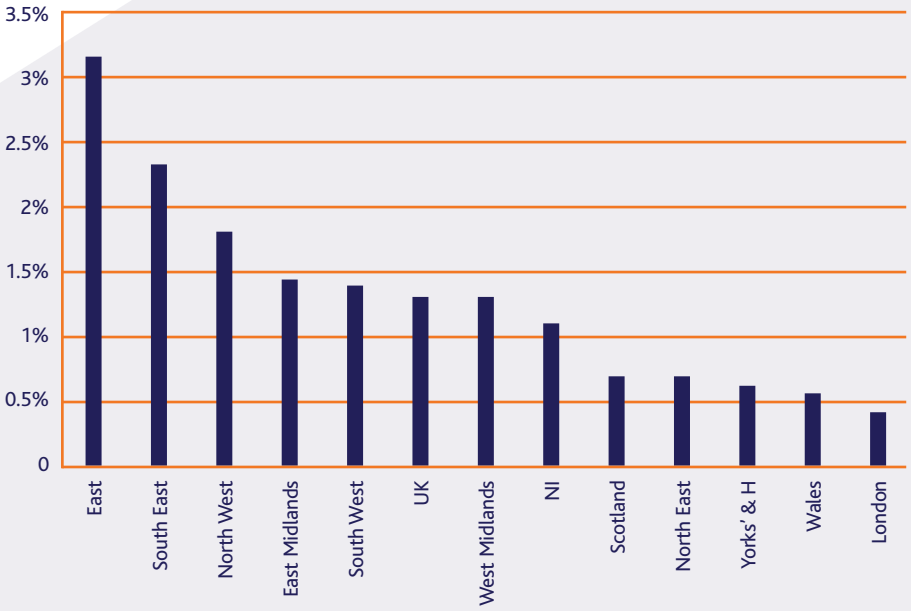
Source: ONS, Business Enterprise Research and Development Survey, 2011

4.4.2 BUSINESS EXPENDITURE ON R&D SUSTAINED

R&D is defined as 'Creative work undertaken on a systematic basis in order to increase the stock of knowledge of man, culture and society and the use of this stock of knowledge to devise new applications'. Business expenditure on R&D, or BERD is the component that is carried out by businesses, rather than Government and is generally regarded as the most important source of R&D, which is shown by the literature to have the most influence on productivity and economic growth.

NI's performance in terms of BERD is very much in line with the overall R&D figures, with a step change from the 2005-08 average of 0.6% of GVA increasing to 1.1% in 2009 and 10, which increased again in 2011 to 1.2%. The outcome is that NI is ranked seventh of the UK regions and is significantly ahead of its next nearest rival (Scotland) and the other peripheral UK regions.

FIGURE 10: BUSINESS EXPENDITURE ON R&D AS A % OF WORKPLACE GVA, 2011

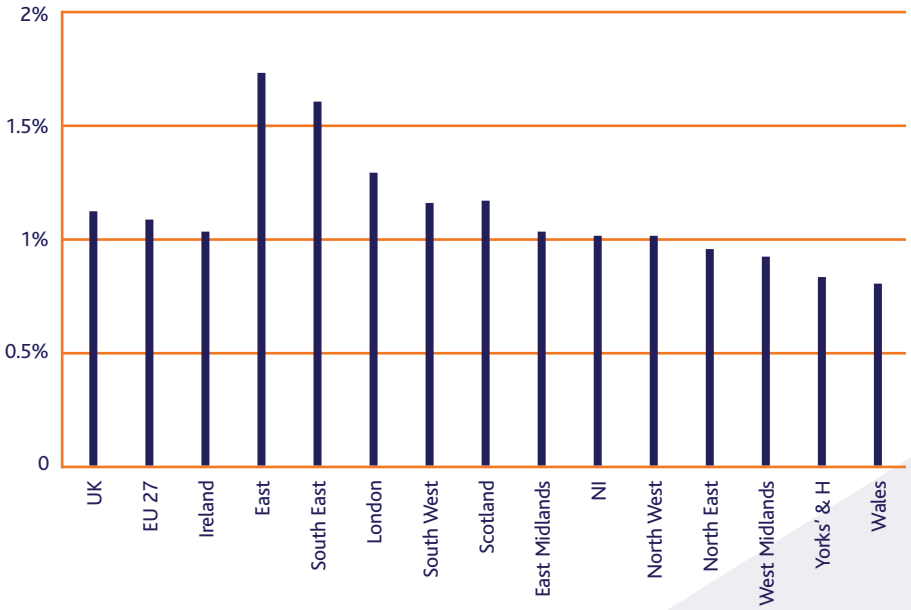


Source: ONS, Business Enterprise Research and Development Survey, 2011

4.4.3 R&D PERSONNEL NUMBERS STABLE

Eurostat data reveals that R&D personnel made up 1.0% of total employment in 2009 (latest available data), which is just below the UK average and close to the Irish and EU 27 averages. The results for the East and South East regions show that they have a significant proportion of employment in R&D (1.8% and 1.6% respectively).

FIGURE 11: R&D PERSONNEL EMPLOYED AS A % OF TOTAL EMPLOYMENT, 2009

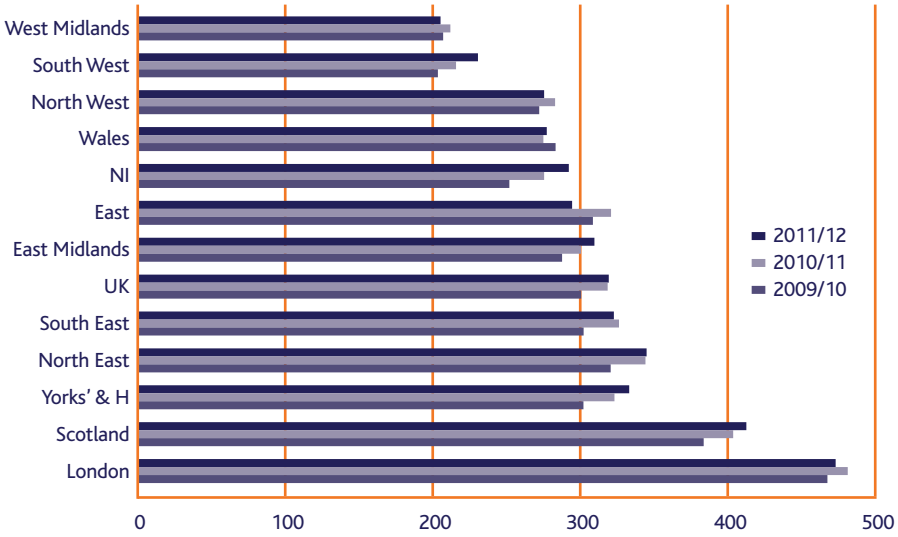


Source: Eurostat

4.4.4 BOOST IN THE NUMBER OF PHDS

PhD graduates are highly skilled individuals who are invaluable when it comes to producing and transferring knowledge in an innovation based economy. Northern Ireland has shown significant increases in the number of PhDs awarded per million inhabitants over the last four years. In 2009/10 225 PhDs were completed per million inhabitants in NI, which increased to 284 by 2011/12. This is a positive trend which moves NI closer toward the UK average of 318 and increased NI's regional ranking from tenth to eighth. London and Scotland both outperform the UK average, due to the concentration of Higher Education Institutions located in each (forty and eighteen respectively).

FIGURE 12: NUMBER OF PHDS AWARDED PER MILLION INHABITANTS

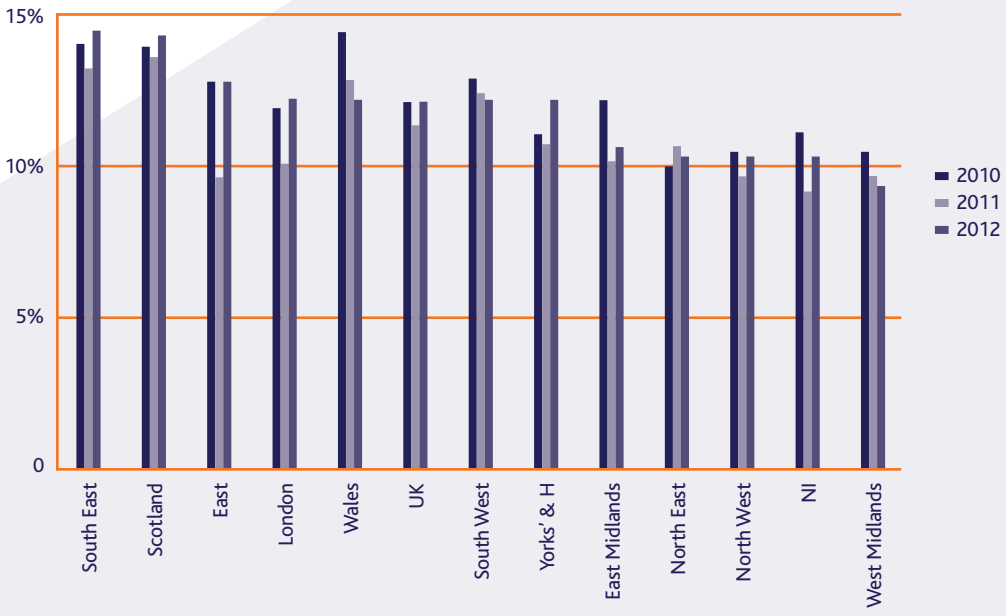


Source: Labour Force Survey
Note: Science and Technology includes biological, veterinary, agricultural and physical scicences, maths and computing, engineering and technology

4.4.5 SCIENCE AND TECHNOLOGY GRADUATES IN THE WORKFORCE PROPORTIONALLY LOW

The supply of skilled labour is important to all economies, but is particularly important to the Knowledge Economy. In 2012, the proportion of science and technology graduates in the workforce jobs in NI was 10.5%, below the UK average of 12.3%. The data is reasonably volatile for a number of the UK regions, as can be seen from the fluctuation in the NI data of one percentage point annually. However NI increased one place in the regional rankings to eleventh in 2012. There is some volatility in the data (see figure 13) and this is indicative of sample size issues within the survey.

FIGURE 13: SCIENCE AND TECHNOLOGY GRADUATES AS A PROPORTION OF WORKFORCE JOBS

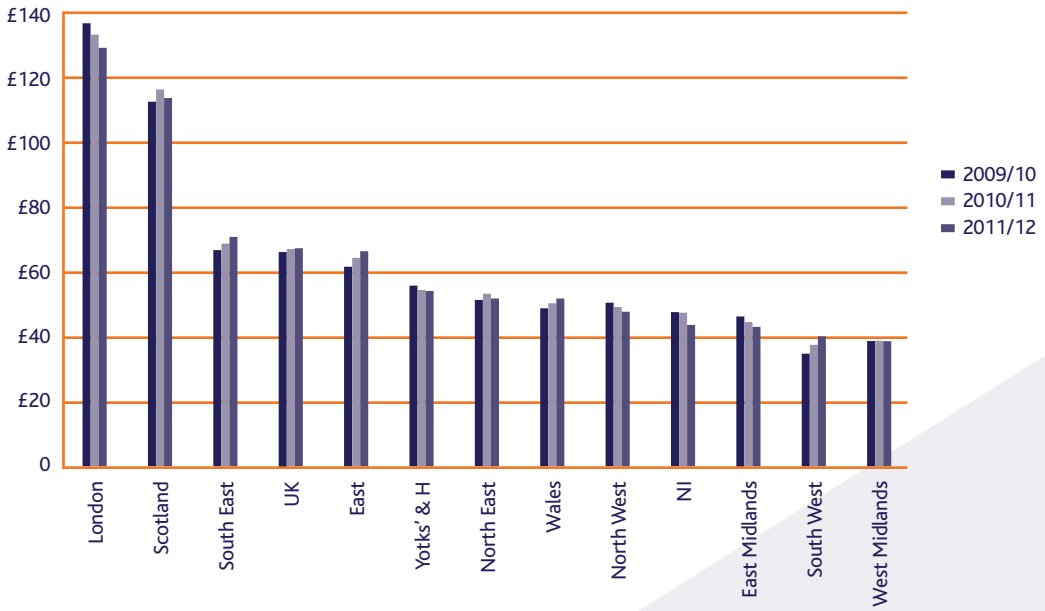


Source: ONS, Interdepartmental Business Register (business starts) & NOMIS (population)

4.4.6 RESEARCH GRANTS AND CONTRACT VALUES FALLING

London and Scotland dominate the UK regional picture as London has approximately £130 worth of research grants and contracts per 1,000 inhabitants and Scotland has £115 . This is significantly ahead of the other regions and the UK average value of £65. Northern Ireland is below the UK average, but is ranked ninth out of the UK regions, which is a good performance for a region with only two universities. However, the total value of research grants and contracts fell from almost £50m in 2009/10 and 2010/11 to £45m in 2011/12.

FIGURE 14: VALUE OF RESEARCH GRANTS AND CONTRACTS PER 1,000 INHABITANTS



Source: Higher Education Information Database for Institutions (HEIDI)

4.4.7 R&D ACTIVITY SUMMARY

R&D is the best performing element of the Knowledge Economy in NI when compared to the UK average and other UK regions, with NI ranked eighth on average. Levels of R&D and BERD as a proportion of GVA have stepped up in recent years and these higher values have been maintained. Three out of six indicators in this section of the KEI have improved by one place (table 13). The policy challenge for other elements of the KEI is to emulate the relative success of the R&D element of the Index and also to keep driving this element forward. It may also be expected that the relative success in this element of the Index should also raise the performance of other elements in future years.

TABLE 13: SUMMARY OF R&D ACTIVITY INDICATORS

R&D Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year
R&D as % of workplace based GVA	1.7%	1.7%	7	=	2011
Business Expenditure on R&D as % of workplace GVA	1.1%	1.2%	7	v	2011
R&D personnel as % of total employment	1.0%	1.0%	6	^	2009
No. of PhDs per million inhabitant	263	284	8	^	2011/12
HEI Research grants and contracts per 1,000 population	£45.1	£44.6	9	=	2011/12
No. of science and tech' graduates (NVQ Level 4+) as % of workforce	9.4%	10.5%	11	^	2012

CASE STUDY – RANDOX LABORATORIES LTD

Starting in 1982 with six people, Dr Peter FitzGerald has grown his business to employ over 1,200 staff across headquarters in Northern Ireland and in Randox offices worldwide. Dr FitzGerald was working in the research department of Queen's University Belfast when his passion for science and his observation of the 'brain drain' of young talented scientists prompted him to set up a local manufacturing facility for diagnostic products. The focus since has been on the development of better, more sensitive tests for existing diagnostic parameters, and keeping abreast of new trends and developments by devoting 30% of the company's revenue to research.

Randox is committed to saving lives by ensuring individuals worldwide have access to timely and correct diagnosis and its products are used in over 145 countries worldwide by:

- Hospital Laboratories
- Forensic Laboratories
- A&E Units
- Food & Wine Laboratories
- Sports Organisations
- Horse Racing Authorities
- Veterinary Clinics
- Pharmaceutical Companies
- CRO Companies

Among its many achievements the company designed the Biochip Array Technology (BAT) that has changed the way we think of diagnostic testing. Instead of a patient sample needing to be subdivided for each test result, BAT offers a diagnostic patient profile with each patient sample. Randox has now expanded its product portfolio to over 1500 products and through heavily committed Research & Development programmes has diversified into many other aspects of science. The culmination of 30 years of R&D resulted in the award of the 2013 Innovation Founder of the Year to Dr Peter FitzGerald for his extraordinary contribution to international biochemical research and impact on the NI economy.

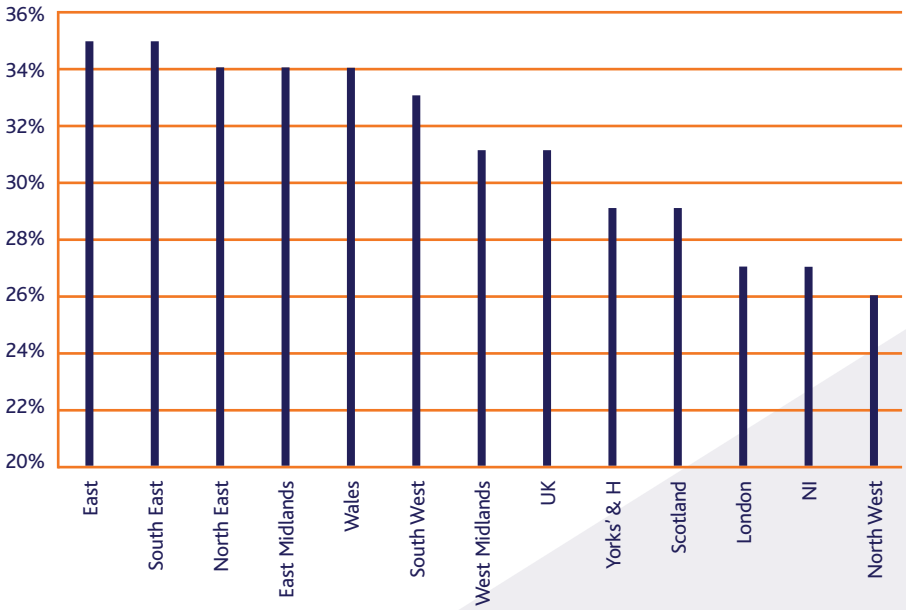
Source: NI Science Park and Randox Laboratories LTD

4.5 INNOVATION AND PATENT ACTIVITY

4.5.1 INNOVATION ACTIVITY REMAINS LOW

The 2012 UK innovation survey published by DETI presents the data over a three year period from 2008-10 inclusive. Unfortunately the innovation data is not directly comparable over time, due to changes in the questions that are used to identify which firms are innovation active. The latest available data shows that NI has the second lowest proportion of businesses that are innovation active of the UK regions (27%), four percentage points lower than the UK.

FIGURE 15: PROPORTION OF ENTERPRISES THAT WERE INNOVATION ACTIVE, 2008-2010



Source: DETI, UK Innovation Survey

4.5.2 PATENT ACTIVITY REMAINS LOW RELATIVE TO OTHER UK REGIONS

Patents bring innovation and inventions to the market. Applying for a patent makes an invention public but offers protection at the same time. A count of patents granted helps to measure a region's innovative activity and is reflective of its capacity to exploit knowledge and its ability to transform it into potential economic gains. However in tough economic times patent budgets do become constrained and patent investment more selective.

NI and the North East of England are consistently the lowest ranked regions in terms of patent applications filed and granted. As with many of these types of indicators, the south eastern corner of England ranks highest. What may be of more concern however, is NI's relatively low conversion ratio from applications filed to applications granted – an average of 7.8% compared to 19.4% in the UK.

It is perhaps surprising that NI's improving performance across the R&D indicators, especially in R&D as a % of GVA and BERD as a % of GVA do not seem to be feeding through to higher numbers of patent applications and higher conversion ratios, but this may be explained by significant time lags in terms of bringing products to a market ready state.

TABLE 14: PATENT APPLICATIONS FILED AND GRANTED PER MILLION INHABITANTS, BY UK REGIONS 2011 - 2012

Region	Applications Filed		Patents Granted	
	2011	2012	2011	2012
South East	2,828	2,865	591	614
London	2,701	2,522	401	375
East	1,818	1,821	409	360
North West	1,285	1,426	246	239
South West	1,403	1,398	363	413
West Midlands	1,060	1,130	216	219
Yorkshire	1,127	1,025	175	182
Scotland	991	931	207	190
East Midlands	685	860	155	130
Wales	580	519	82	107
North East	380	358	70	58
Northern Ireland	249	252	16	23
UK	**15,343**	**15,370**	**2,992**	**2,974**
UK % change		**0.2%**		**-0.6%**

Source: UK Intellectual Property Office

An additional source of data on patent applications is the Organisation for Economic Co-operation and Development (OECD) which shows applications to the European Patent Office (EPO) for European protection. The numbers applying for European protection is lower than the numbers recorded for the UK Intellectual Property Office, as not all applications to the UK IPO are also submitted to the EPO. The data is quite lagged in that the latest available information is for 2009, but what can be seen clearly is the impact of the recession in that all regions of the UK experienced a decline in patent applications in 2009. Northern Ireland is the lowest ranking UK region from 2006 to 2009.

TABLE 15: PATENT APPLICATIONS PER MILLION INHABITANTS, BY UK REGIONS 2005 - 2009

	2005	2006	2007	2008	2009
South East	162	165	154	147	75
South West	101	102	100	95	49
East Midlands	84	91	87	90	46
East	174	167	153	129	41
UK	91	92	86	82	35
Scotland	64	76	75	69	33
North East	59	64	53	69	32
West Midlands	62	64	52	56	26
London	68	66	67	58	22
North West	75	65	55	60	20
Yorkshire and The Humber	62	55	63	54	17
Wales	38	45	42	39	17
NI	38	42	35	33	11

Source: OECD, EPO patents applications by inventor

An important component of these patent applications to the EPO are those that are in the high technology field, potentially providing the most important safeguards to products and processes that could have the greatest commercial potential. Again, NI is ranked twelfth of the UK regions, but this has not always been so, as it has slipped back from being ninth, seventh and eleventh in 2005, 6 and 7 respectively. The drop off in high-tech patent applications has also been more marked in NI than in other UK regions from 2008-09.

TABLE 16: HIGH TECHNOLOGY PATENT APPLICATIONS PER MILLION INHABITANTS, BY UK REGIONS 2005 - 2009

	2005	2006	2007	2008	2009
South East	116	105	96	91	47
East	135	123	109	90	23
Scotland	49	49	41	42	20
UK	**57**	**52**	**49**	**44**	**16**
South West	57	55	53	51	16
London	55	48	47	38	13
East Midlands	39	29	34	27	10
North East	17	23	20	25	8
Wales	21	21	25	20	8
Yorkshire and Humber	28	21	32	22	7
West Midlands	22	25	18	21	6
North West	35	27	22	18	6
Northern Ireland	23	29	20	16	4

Source: OECD, EPO patents applications by inventor

4.5.3 INNOVATION AND PATENT ACTIVITY SUMMARY

NI's performance in the innovation and patent activity element of the KEI is the weakest of the three key areas. NI lags behind the UK average in all indicators and was ranked as the lowest of the UK regions in four out of the five indicators, and second from last in the final indicator.

It would be reasonable to expect that with the relative success of the R&D element of the index that some of the activity should begin to feed into the commercialisation of products and processes, which should then be reflected in the patent indicators. It is also worrying that NI has a lower conversion ratio than other UK regions in terms of patents applied for and patents granted. As such, further research should be conducted into the commercialisation of R&D&I in NI, to establish why the numbers of patent applications are low, what policy measures may help and what programmes could be offered or augmented in NI.

TABLE 17: SUMMARY OF INNOVATION ACTIVITY INDICATORS

Innovation and Patent Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year
% of firms stating that they are innovation active	27.0%	27.0%	11	=	2008-10
No. of patent applications per million inhabitant (to EPO)	33	11	12	=	2009
No. of high technology patents per million inhabitant (to EPO)	16	4	12	=	2009
No. of patent applications filed per million inhabitant (to UK IPO)	138	139	11	^	2012
No. of patents granted per million inhabitant (to UK IPO)	9	13	12	=	2012

PATENT ACTIVITY AND POLICY FRAMEWORKS

Further research should be conducted into the commercialisation of R&D&I in NI, to establish why the numbers of patent applications are low in NI, what policy measures may help and what programmes could be offered or augmented in NI.

CASE STUDY – DISPLAYNOTE

DisplayNote is a new interactive screencasting app for computers, tablets and phones designed to end death by powerpoint. Designed in Northern Ireland the DisplayNote app will re-invent digital meetings, presentations, workshops and the classroom with the most comprehensive and accessible software which is being validated by significant sales into global markets across a wide range of sectors.

The company, based in the NI Science Park, is still within its 2nd year but is already selling into some of the world's biggest tech firms. One major success has been to secure partnerships with hardware manufacturers. NEC in Japan is bundling DisplayNote with all its interactive projectors so almost one million units are being distributed globally without the team having to sell directly to the end user. Other tech company partnerships include Sahara in the UK and BenQ in Taiwan, alongside a growing global network.

In the US, it's the education sector that is driving much of the uptake. Some school districts have adopted DisplayNote for roll-out to tens of thousands of students at a time. And their feedback has been very positive. With the increasing popularity of BYOD (Bring Your Own Device), and the interactive opportunities that connected devices – mobiles, tablets, laptops, desktop computers – bring, the whole realm of teaching and presenting is going through a revolutionary overhaul.

Besides the office in Belfast, DisplayNote also has a development team in Spain. A recent team acquisition, Andy Penman, will be bringing over a decade's experience to the set-up of further operations on the US west coast to develop the business there. In parallel, support services for end users are a priority. And on the technical side, we can expect soon to see cloud support so groups can interact remotely, plus support for Apple's Airplay for easy screen sharing. DisplayNote is marching into a busy product space but there's much to play for with the potential impact of improving the way we teach and communicate. The team imagines a near future where students walking into classrooms, or business people into meetings, automatically ask the presenter, "do you have DisplayNote?"

Source: NI Science Park and DisplayNote

5 CONCLUSIONS

5.1 OVERARCHING SUMMARY

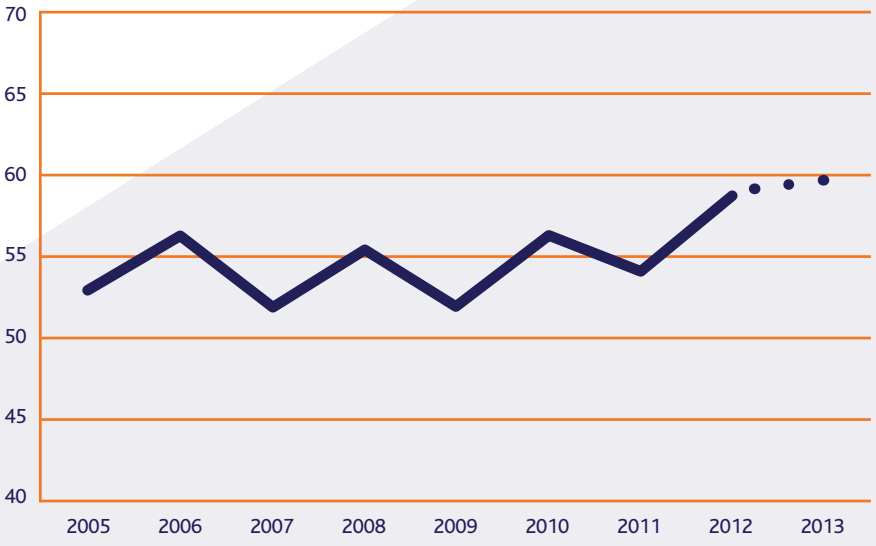
This has been a successful year for the Knowledge Economy. NI has continued to catch up with the UK and the new composite Knowledge Economy Index has been developed for NISP CONNECT which will help to monitor and report on the overall health of the sector. Significant challenges remain in that NI still lags behind the UK in terms of the development of its Knowledge Economy. There are issues with data and additional research is required in a number of areas but as the Knowledge Economy indices show, progress has been made.

5.2 COMPOSITE KNOWLEDGE ECONOMY INDEX

The development of the new composite Knowledge Economy Index is a key development within the NISP CONNECT programme. It will enable the relative health of the sector to be monitored and reported upon consistently and effectively. It will also act as a barometer in terms of how successful economic development policy is in the R&D, Innovation and Creativity arena.

Since 2005, the Index shows that the NI Knowledge Economy has performed reasonably well, particularly from 2011 to 2012, closing the gap with the UK.

FIGURE 16: NI COMPOSITE KNOWLEDGE ECONOMY INDEX (UK = 100)



Source: NICEP
Note: 2013 is a forecast

5.3 KNOWLEDGE ECONOMY – SUMMARY OF KEY INDICATORS

Overall, as shown in Table 18 below, there has been a mixed performance in the innovation metrics in Northern Ireland across investment activity, R&D and research activity and innovation and patent activity.

In summary:

Core metrics

NI's performance has been reasonably strong in a number of indicators, however, other UK regions have also performed well and as a result, NI's regional ranking has dropped by one place in two out of four of these indicators and remained the lowest of the UK regions in the others.

Investment activity

NI's performance has been mixed, with a flurry of relatively small VC deals pointing to a reasonable level of activity in this market. However, despite this activity, overall values remain low in UK relative terms and there are still very low numbers of listed companies in NI and low levels of Merger and Acquisition activity. Further research is required to answer questions around lack of demand, constricted supply or both in this sector and the policy measures that may help correct any failings.

R&D and research activity

This element of the Knowledge Economy Index is where NI posts its strongest performance, with R&D, BERD and R&D personnel levels close to the UK level and NI regional rankings just below the mid table and a reasonably successful performance in terms of PhDs per million population and research grants and contracts.

Innovation and patent activity

Remains low in NI and the latest available data shows that all regions have been impacted negatively by the recession, but NI more so than most other regions. In addition, NI has the lowest conversion ratio of the UK regions from patents applied for to patents granted.

TABLE 18: SUMMARY OF KNOWLEDGE ECONOMY INDICATORS

Knowledge Economy - Core characteristics (CONNECT definition)	Previous year	Latest data	Year	Regional ranking	Progress since last year (ranking)	Source
KE employment, as % of total employment	4.6%	4.8%	2011	9	v	COE / BRES
KE businesses, as % of total business stock	4.0%	4.2%	2011	12	=	IDBR
KE business start ups per 100,000 population*	14	16	2011	12	=	IDBR / NOMIS
Science and Technology employees average wage level (per week)	£573	£544	2012	12	v	Labour Force Survey

Investment Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
No. of private equity and VC investments (no. of companies)	13	26	12	=	2012	BVCA
No. of private equity investment per 100,000 VAT registered businesses	16	31	6	^^^^	2012	BVCA
No. of venture capital investment per 100,000 VAT registered businesses	12	29	2	^^^^	2012	BVCA
Amount of VC investment, £M	£20	£2	12	vvvvvvv	2012	BVCA
No. of M&A and ECM deals per 100,000 VAT registered businesses	66	89	12	=	2012	Experian Corpfin
Public listed companies: Market capitalisation per head	£169	£251	10*	=	2013	London Stock Exchange*

Notes: * London Stock Exchanges definition of UK regions includes 10 rather than 12 regions.
^Represents an increase in regional ranking by one place; = represents an unchanged regional ranking; and v represents a decrease in regional ranking by one place.

R&D Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
R&D as % of workplace based GVA	1.7%	1.7%	7	=	2011	UK R&D Survey
Business Expenditure on R&D as % of workplace GVA	1.1%	1.2%	7	v	2011	UK R&D Survey
R&D personnel as % of total employment	1.0%	1.0%	6	^	2009	Eurostat
No. of PhDs per million inhabitant	263	284	8	^	2011/12	HEIDI
HEI Research grants and contracts per 1,000 population	£45.1	£44.6	9	=	2011/12	HEIDI
No. of science and tech' graduates (NVQ Level 4+) as % of workforce	9.4%	10.5%	11	^	2012	Labour Force Survey

Innovation and Patent Activity	Previous year	Latest data	Regional ranking	Progress since last year (ranking)	Year	Source
% of firms stating that they are innovation active	27.0%	27.0%	11	=	2008-10	DETI UK Innovation Survey
No. of patent applications per million inhabitant (to EPO)	33	11	12	=	2009	OECD
No. of high technology patents per million inhabitant (to EPO)	16	4	12	=	2009	OECD
No. of patent applications filed per million inhabitant (to UK IPO)	138	139	11	^	2012	UK IPO
No. of patents granted per million inhabitant (to UK IPO)	9	13	12	=	2012	UK IPO
Public listed companies: Market capitalisation per head	£169	£251	10*	=	2013	London Stock Exchange

5.4 BUILDING AN EVIDENCE BASE FOR COMPANIES AND POLICY

The research has revealed a number of areas where additional research would be of benefit in terms of increasing the level of understanding of the sector, filling important gaps in the data and bringing forward additional evidence that will help grow the Knowledge industry.

The key recommendations, outlined in detail earlier in the report are;

5.4.1 Open and improved data

Access for researchers to surveys such as the Annual Survey of Hours and Earnings and addressing the sometimes significant time lags in official data that inhibit the development of rapid economic policy changes when required. These issues need to be addressed across all areas of economic activity in NI, not just for the Knowledge Economy.

5.4.2 Venture capital data issues

Linked to open and improved data, there is no single data source that captures and reports on all of the Venture Capital activity in NI. The BVCA is the best data source available, but does not include a number of investments. Those within the sector and Government should consider working together to augment the BVCA survey in order to ensure that there is a single source that captures and reports on all NI VC data, which could then reliably inform policy development.

5.4.3 Full economic impact assessment

Consideration should be given to carrying out additional research into modelling the overall economic impact of the sector in NI, by including the downstream effects. Evidence from San Diego suggests that the Knowledge Economy multiplier could be higher than the whole economy average, given the relatively high wages and applicability of knowledge across sectors and technologies.

5.4.4 The financial landscape

The debate on the demand for and supply of Venture Capital in NI continues to unfold. DETI are in the process of commissioning

research on access to finance in NI, based on a recommendation from the Economic Advisory Group. This important piece of research will bring forward more evidence that will help inform the debate. It is essential that the sources of finance for firms in NI with ambitions to grow are mapped, alongside the evidence of demand from these companies in order to fully understand the potential for firms to effectively 'absorb' new higher levels of funding.

5.4.5 VC - North East exemplar and East of England's alternatives

The North East of England has been the most successful UK region, by a significant degree, in terms of Venture Capital and the East of England has performed relatively poorly. Additional research should be undertaken in order to understand the driving factors and policy environment that underpin the strong performance in the North East and also, given the amount of R&D that takes place in the East of England, what alternative financing arrangements are available for innovative businesses.

5.4.6 Patent activity and commercialisation

Further research should be conducted into the commercialisation of R&D and innovation activity in NI and its potential impact on economic growth in NI. This research will help to establish why the numbers of patent applications and conversions to patents granted are low in NI, what policy measures may help and what programmes could be offered or augmented in NI.

5.4.7 Matched study with San Diego

Given the genesis of the programme in San Diego, a matched firms study would be particularly valuable for NI in order to understand differences in management practices, behaviours and cultures that are prevalent, how companies here may adopt better practices for greater economic benefit and how policy may be formed in order to help such companies grow in the Knowledge Economy in NI.

5.5 MOVING IN THE RIGHT DIRECTION

Over the past year, the Knowledge Economy in NI has made good progress in a number of areas. The newly developed composite Knowledge Economy Index confirms this, as NI has continued to catch up with the UK, but from a significantly lower base. The index provides a new perspective on the overall health of the sector and should be widely used in the development of innovation oriented strategies.

It is important to acknowledge that this is a dynamic game. All UK regions are striving to grow their knowledge economies, increase employment and productivity and increase overall standards of living. Therefore, the NI Knowledge Economy must continue to strive not just to be average, but to be better than average and continue to grow more rapidly if it is to deliver on the aspirations set out in earlier reports within this series.

There are a significant number of challenges that NI must overcome on the road to delivering these aspirations. There are a number of data issues in terms of gaps and lags, and there are a number of areas where additional research and knowledge will be of benefit in terms of learning from the successes and apparent alternatives that may prevail in other regions. NI can learn from other regions, but must also "know itself" in terms of the data, behaviours and cultures that are at play in the Knowledge Economy in NI. We should also carry out further research to fully understand how the Knowledge Economy impacts on the wider economy in NI and also carry out the complementary research on a region that NI may aspire towards, such as San Diego.

The Knowledge Economy is a small, vibrant and vital sector of the NI economy, providing highly skilled and well-paid jobs, exporting across the globe and helping to deliver on many of the Programme for Government, MATRIX and Innovation Strategy targets. It must be cultivated, with an accommodative policy environment, support from the business and trade organisations and, most essentially, sustained drive from within the sector to succeed.

APPENDIX A: KNOWLEDGE ECONOMY SECTORAL DEFINITIONS

CONNECT DEFINITION

Sector	SIC 2007 Definition	
Medical Devices	26511 Manufacture of electronic instruments & appliances for measuring, navigation, except industrial	32500 Manufacture of medical and dental instruments and supplies
	26513 Manufacture of non-elect' instruments & appliances for measuring, testing and navigation, except industrial	72190 Other research and experimental development on natural sciences and engineering
	26600 Manufacture of irradiation, electromedical & electrotherapeutic equipment	74202 Other specialist photography
	26701 Manufacture of optical precision instruments	
Pharma / Biotechnology	21100 Manufacture of basic pharmaceutical products	72110 Research and experimental development on biotechnology
	21200 Manufacture of pharmaceutical preparations	
IT services	62020 Computer programming, consultancy and related activities	62090 Other information technology and computed service activities
	62030 Computer facilities management	63110 Data processing, hosting and related activities
Communications	26301 Manufacture of telegraph and telephone apparatus and equipment	61900 Other telecommunications activities
	26309 Manu of communications equipment	
Computing and advanced electronics	26200 Manufacture of computers and peripheral equipment	27110 Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus
	26512 Manufacture of electronic industrial process control equipment	27200 Manufacture of batteries and accumulators
	26110 Manufacture of electronic components and boards	27310 Manufacture of fibre optic cables
	26400 Manufacture of consumer electronics	27900 Manufacture of other electrical equipment
	26512 Manufacture of electronic industrial process control equipment	
Other technical consultancy services	71121 Engineering design activities for industrial process & production	74100 Specialised design activities
	71122 Engineering related scientific and technical consulting activities	74901 Environmental consulting activities
	71200 Technical testing and analysis	
Aerospace & Transport	28110 Manufacture of engines and turbines, except aircraft, vehicle & cycle engines	29310 Manufacture of electrical and electronic equipment for motor vehicles
	28120 Manufacture of fluid power equipment	29320 Manufacture of other parts and accessories for motor vehicles
	28131 Manufacture of pumps	30110 Building of ships and floating structures
	28132 Manufacture compressors	30120 Building of pleasure and sporting boats
	28150 Manufacture of bearings, gears, gearing and driving elements	30200 Manufacture of railway locos
	29100 Manufacture of motor vehicles	30300 Manufacture of air and spacecraft and related machinery
	29201 Manufacture of bodies	30400 Manufacture of military fighting vehicles
	29202 Manufacture of trailers and semi-trailers	
Creative Content	59111 Motion picture production activities	59200 Sound recording and music publishing activities
	59112 Video production activities	18201 Reproduction of sound recording
	59113 Television programme production activities	18202 Reproduction of video recording
	59120 Motion picture, video and television post production activities	
	18203 Reproduction of computer media	
Software	58210 Publishing of computer games	62012 Business and domestic software development
	58290 Other software publishing	63120 Web portals
	62011 Computer programming activities	

EUROSTAT

DEFINITION OF EUROSTAT SERVICES BY KNOWLEDGE INTENSITY

Sub-sector	Sector coverage
Knowledge-intensive high-technology services	Motion picture, video and television programme production sound recording and music publishing activities, Programming and broadcasting activities, Telecommunications, Computer programming, consultancy and related activities, scientific research and development
Knowledge-intensive market services (excluding finance and high-technology services)	Water transport, and Air transport, Legal and accounting activities, Activities of head offices; management consultancy activities, Architectural and engineering activities; technical testing and analysis, Advertising and market research, Other professional, scientific and technical activities Employment activities and Security and investigation activities
Financial and insurance activities	Finance and insurance
Other knowledge intensive services	Publishing activities, veterinary activities, public administration/defence, social security, education, human health and social work, arts, entertainment and recreation. Less knowledge – intensive market services Wholesale & retail trade, repair of motor vehicles, land transport, warehousing and support activities, accommodation and good service activities, real estate activities, rental and leasing activities, travel agency, services to buildings and landscape activities, repair of computers and personal/household goods.
Other less knowledge-intensive services	Postal and courier activities; activities of membership organisations; other personal activities; activities of households as employers of domestic personnel

DEFINITION OF EUROSTAT MANUFACTURING BY LEVEL

Sub-sector	Sector coverage
High-technology manufacturing	Manufacture of pharmaceuticals and computer, electronic and optical products
Medium high-technology	Chemicals and chemical products; electrical equipment; machinery and equipment, motor vehicles; transport equipment
Medium low-technology	Coke and refined petroleum products; rubber & plastic products; non-metallic mineral products; basic & fabricated metals; repair / installation of machinery
Low-technology	Food products, textiles, wood, paper, printing, furniture etc.
Other less knowledge-intensive services	Postal and courier activities; activities of membership organisations; other personal activities; activities of households as employers of domestic personnel

APPENDIX B: ABOUT CONNECT

A programme of the Northern Ireland Science Park, NISP CONNECT is modelled on and supported by the successful CONNECT non-profit organisation in San Diego, which was originally part of the University of California, San Diego.

CONNECT sets out to bring aspiring science and technology entrepreneurs and experienced business people together through a set of tried and tested initiatives to engage and educate. CONNECT recognises that the way to overcome the entrepreneurial challenge in economies like Northern Ireland's is to:

- Give the most promising would be entrepreneurs pro bono training and mentoring from successful business people and already successful entrepreneurs.
- Increase public policy advocacy.
- Attract international risk capital.
- Open up international markets.
- Research and experiment to find brand new ways to develop the Knowledge Economy.

CONNECT's philosophy is that although the strongest political support is needed, the private sector must lead – and independent funding from philanthropy, membership, sponsorship and appropriate contracts is paramount.

This commitment of independent time and resource enables NISP CONNECT to perform vital activities, organising events and forums to bring together all the players in the innovation ecosystem. The knowledge flows, high levels of trust, collaborative capacity and nimbleness needed in entrepreneurial ventures are significantly enabled by this combination of geographic propinquity and boundary-spanning activities.

APPENDIX C: KNOWLEDGE ECONOMY INDEX WEIGHTS

The Knowledge Economy Index is a composite index in that includes all twenty one of the indicators that are listed in table 1. It is calculated using the weighted average growth rate of each of the indicators from 2005. The weights for each of the four elements of the Knowledge Economy Index are detailed below.

Section	Weight
Knowledge Economy-Core characteristics (CONNECT definition)	40%
Investment Activity	20%
R&D and Research Activity	20%
Innovation and Patent Activity	20%

NISP CONNECT

A programme of Northern Ireland Science Park, NISP CONNECT is modelled on and supported by the successful CONNECT non-profit organisation in San Diego, which was originally part of the University of California, San Diego.

CONNECT sets out to bring aspiring science and technology entrepreneurs and experienced business people together through a set of tried and tested initiatives to engage and educate.

CONNECT recognises that the way to overcome the entrepreneurial challenge in economies like Northern Ireland's is to:

- Give the most promising would be entrepreneurs pro bono training and mentoring from successful business people and already successful entrepreneurs.
- Increase public policy advocacy.
- Attract international risk capital.
- Open up international markets.
- Research and experiment to find brand new ways to develop the knowledge economy.

CONNECT's philosophy is that although the strongest political support is needed, the private sector must lead – and independent funding from philanthropy, membership, sponsorship and appropriate contracts is paramount.

This commitment of independent time and resource enables **NISP CONNECT** to perform vital activities, organising events and forums to bring together all the players in the innovation ecosystem.

The knowledge flows, high levels of trust, collaborative capacity and nimbleness needed in entrepreneurial ventures are significantly enabled by this combination of geographic propinquity and boundary-spanning activities.

NICEP
Northern Ireland
Centre for Economic Policy

NI Centre for Economic Policy
Ulster Business School
University of Ulster
BT37 0QB

Tel: 028 9036 8128
email: nicep@ulster.ac.uk

Lead author:
Richard Johnston, NICEP

Team:
Neil Gibson, NICEP
Mark Magill, Oxford Economics
Giulia Montefiore, Durham University

OXFORD ECONOMICS

Department of
Enterprise, Trade and Investment
www.detini.gov.uk

European Union
European Regional Development Fund
Investing in your future

Report prepared by NICEP for Northern Ireland Science Park CONNECT

Project part financed by the European Regional Development Fund under the European Sustainable Competitiveness Programme for Northern Ireland.