

THE KNOWLEDGE ECONOMY IN NORTHERN IRELAND

— SEPTEMBER 2015

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The Knowledge Economy is a growing sector of the Northern Ireland (NI) economy, which provides highly skilled and well-paid jobs. It is important for economic development as it is export intensive, has high productivity and generates wealth from outside NI, contributing to the successful delivery of many of the Programme for Government, MATRIX and Innovation Strategy targets.

The Knowledge Economy is important to many outside the sector, as it has a well-developed supply chain within NI and highly paid employees spend their wages on a range of goods and services, supporting employment in the retail,

hospitality and construction sectors. This research also found that Knowledge Economy firms are spread across NI, providing employment opportunities.

NI Knowledge Economy - 2015 headlines

This research analysed the Knowledge Economy from a new perspective, utilising newly available data on exports, productivity, Gross Value Added (GVA) and wages. The key findings from the research this year were that;

1. The Knowledge Economy is externally focused, generating wealth from abroad - 85% of Knowledge Economy sales are outside Northern Ireland
2. Knowledge Economy salaries and productivity are around 50% higher than the average in Northern Ireland
3. The Knowledge Economy makes up 5% of the NI economy and for every job another job is created - this multiplier of 2 makes 10%
4. There were 410 Knowledge Economy startups in the past year
5. Northern Ireland has the second fastest growing Knowledge Economy Index in UK for the second year running, now ranked 10th of the 12 regions
6. Knowledge Economy companies are spread across Northern Ireland, providing employment opportunities in all areas
7. The number of PhDs awarded by our universities reduced, raising concerns regarding the impact of austerity on the Knowledge Economy



10% of the NI economy depends on the Knowledge Economy



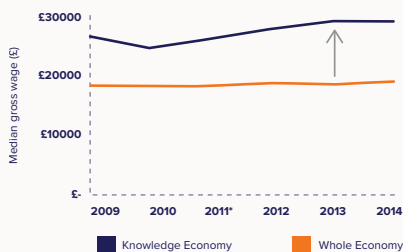
1 in 10 people in NI are employed directly or indirectly by the Knowledge Economy

	Employment	GVA
Direct	35,900	£2.1bn
Indirect	25,000	£0.9bn
Induced	15,000	£0.5bn
Overall multiplier	2.0	1.7
Total	76,000	£3.4bn

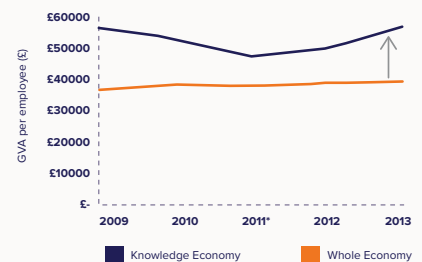


10% of NI GVA is generated directly or indirectly by the Knowledge Economy

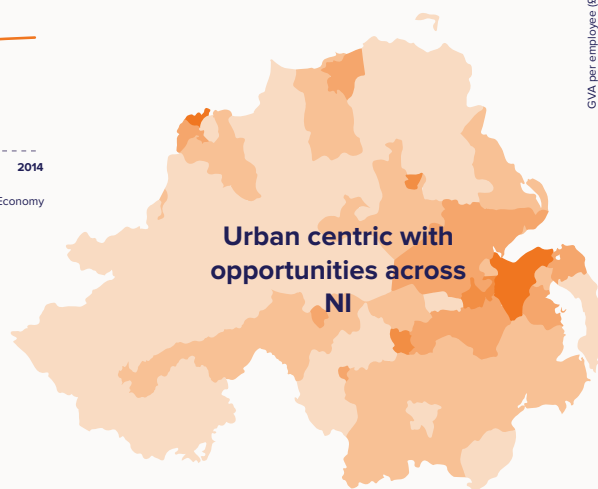
Knowledge Economy direct employees earn one and a half times the NI average



Knowledge Economy direct employees produce one and a half times the NI average



Location of Knowledge Economy Firms

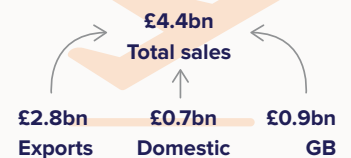


Urban centric with opportunities across NI

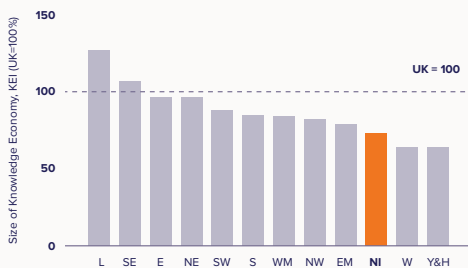


410 Knowledge Economy business start-ups

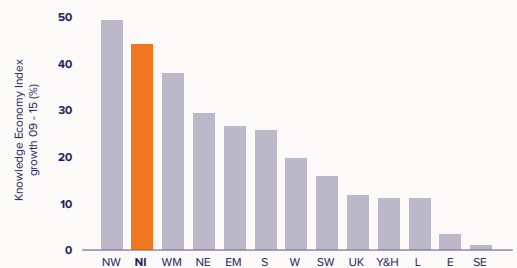
85% of Knowledge Economy sales are outside NI



NI Knowledge Economy is ranked tenth of the 12 UK regions



NI has the 2nd fastest growing Knowledge Economy in the UK



Progress towards 2030 targets

ABOVE	ON TARGET	BELOW
Knowledge Economy bus' startups	Knowledge Economy employees	Knowledge Economy bus' (total)
No. of VC inv' (deals)	Knowledge Economy wage premium	VC inv' (£m)
M&A and ECM activity (deals)	No. private equity inv' (companies)	No. Public Listed Companies
Total expenditure on business R&D, £m	Total expenditure on R&D, £m	HEI research grants & contracts, £m
No. R&D personnel	No. PHDs, per annum	No. Science & Tech' grads (NVQ 4-)
Proportion of innovation active firms	-	No. patent apps, per mil pop
-	-	No. high tech patent apps, per mil pop

Key: Core indicator Investment R&D Innovation

First Derivatives

First Derivatives is a leading provider of products and consulting services to the capital markets industry. Focused on financial institutions that work cross-asset, often with multi-system and/or high volume trading activities, the company scopes, designs, develops, implements and supports a broad range of mission critical data and trading systems across front, middle and back-office operations.

In 1996, Brian Conlon established First Derivatives in Newry growing the company from a zero base with seed capital of just £10k to its current position as one of only three PLC's based in Northern Ireland and a consolidated turnover of over £80m

The group now employs more than 1,000 people worldwide and counts many of the world's top investment banks, brokers and hedge funds as its customers.

Having graduated from Queen's University Belfast in 1988 with a degree and a postgraduate diploma in accounting, Brian Conlon took up employment as a trainee accountant with KPMG, subsequently moving to London as a risk controller with Morgan Stanley International, where he was responsible for risk control for the derivatives and fixed income desk.

After four years with Morgan Stanley, Brian took up employment as a financial engineer with Infinity, where he was responsible for pre and post sales support for a mission critical software package, working with some 60 financial institutions throughout Europe, the US and Asia.

From there, he came home to set up First Derivatives.

The company has been profitable since its inception and in 2002, FD floated on the London Stock Exchange's Alternative Investment Market ("AIM") and since flotation has demonstrated continued growth in revenue, profitability and employment levels. It has broadened its service offering to include the sale of software products on behalf of third parties and the development and sale of its own range of software products.

First Derivative's vision is to become the technology leader in the field of Big Fast Data across multiple sectors and to be one of the world's largest consultancies for the financial, technology and energy industries.

The company's principle objective is to maximize shareholder value.

FD has continued to expand its service offering and now has operational bases in London, New York, Stockholm, Tokyo, Toronto, Sydney, Dublin, Hong Kong, Singapore and Johannesburg.

Acquiring its first subsidiary, Market Resource Partners (MRP) in September 2008, since then it has made a number of further strategic acquisitions the most notable of which was US technology company Kx Systems Inc in 2014.

3.1

WHAT IS THE KNOWLEDGE ECONOMY?

Knowledge economies comprise of individuals, companies and sectors that create, develop, hone and commercialise new and emerging ideas, technologies, processes and products and export them around the world.

In order to maintain their competitive advantage these companies constantly strive to remain at the forefront of their industry by recruiting highly skilled individuals, investing in R&D, innovation, encouraging creativity, marketing and seeking out new markets.

3.1.1. Components of the Knowledge Economy

The sectors are both knowledge intensive and export oriented and therefore have the capacity to grow the NI economy through high value added exports. This year, for the first time, high-tech financial services are included in the definition.

The sectors included are:

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

A full list of Standard Industrial Classification (SIC) sectors used to define the Knowledge Economy is included in Annex A. These sectors align closely with the Matrix themes. A sectoral definition can only ever be a best approximation

The Knowledge Economy is a vital element of every developed economy around the world as it contributes to and enhances their global competitiveness, which in turn increases their rate of economic growth.

of what is included in the Knowledge Economy. The NISP CONNECT definition focusses on sectors that are both export oriented and knowledge intensive and as a result, companies that may be knowledge intensive and serve the domestic market (such as conveyancing lawyers) are not included as whilst they are Knowledge intensive, they are not externally focussed. Equally, there is knowledge embodied in all sectors, including farming, food processing and mining. These sectors will employ software engineers, accountants and designers etc. although the general principle is that the use of knowledge is less intensive in these sectors.

Using a sectoral definition is a helpful guide which allows relevant data to be gathered and compared with the rest of the economy and is an approach which is used in Knowledge Economy studies across the world. Different studies use different definitions, for instance, the OECD includes healthcare and education. NISP CONNECT have opted to retain a private sector, entrepreneurial and and export orientated focus in their definition, as it is built upon the foundations of the San Diego CONNECT model.

3.2 WHY IS THE KNOWLEDGE ECONOMY IMPORTANT?

3.2.1. Generating wealth and employment in the longer term

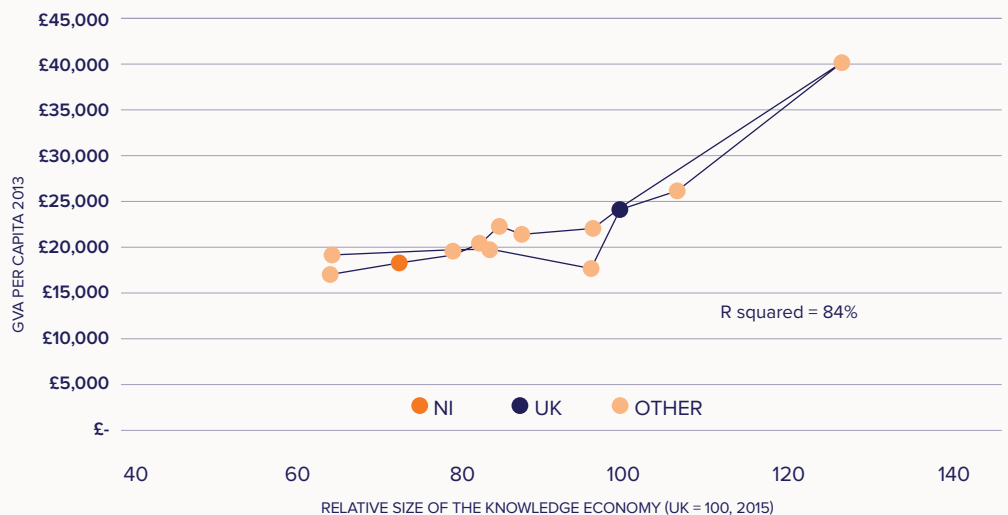
Economic growth can be driven from a number of sources; by consumer expenditure; investment by businesses, governments or households; Government expenditure or the balance of trade and tourism.

The Knowledge Economy is important as it is characterised by high wage, high productivity and highly skilled jobs that provide sustainable employment opportunities by selling beyond NI's shores. There is a strong positive correlation between the relative size of a regional Knowledge Economy and average wealth (measured as GVA per capita), suggesting that the more knowledge intensive an economy

is, the greater the average level of wealth of its citizens. Investment in R&D can take a number of years before the commercial outcomes impact on the wider economy in terms of growing from research employees to development, production, and exports. Completing the R&D, securing patents and funding, marketing, branding and building the customer base may take a number of years and therefore current R&D activity will feed through to improved economic outcomes such as wealth and employment a number of years later if the product is successful.

FIGURE 3.1 GVA PER CAPITA (2013) VS. RELATIVE SIZE OF THE KNOWLEDGE ECONOMY, UK REGIONS (UK=100)

SOURCE: ONS REGIONAL ACCOUNTS, UUEPC KNOWLEDGE ECONOMY INDEX



3.2.2. International experience

International evidence also demonstrates that countries which invest heavily in R&D have better average standards of living. R&D intensity is just one element of the Knowledge Economy Index. Other factors, such as innovation, access to finance and skills also have an impact. NI has been successful

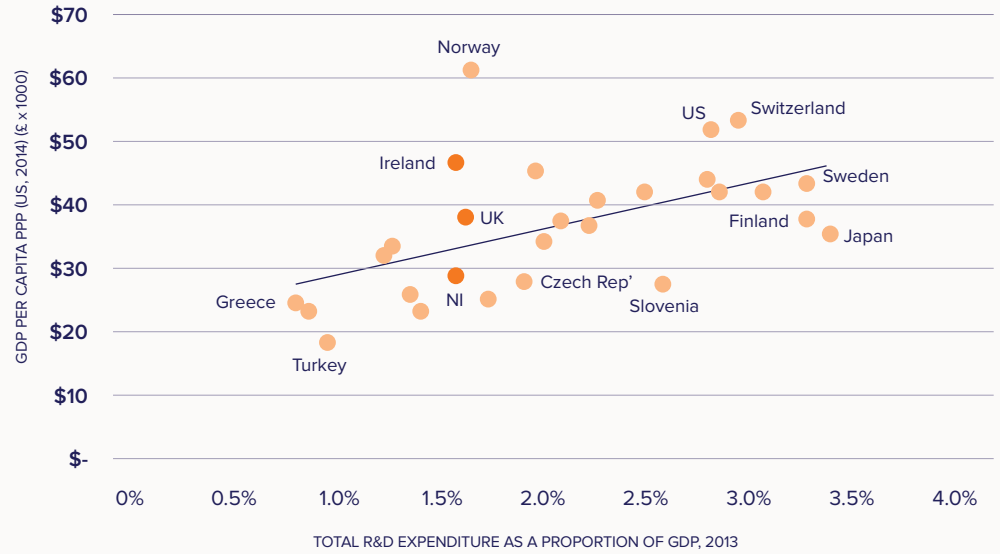
in catching up to UK average levels of R&D in recent years – and now may be the time to focus on succeeding at an international level – perhaps by targeting R&D intensity of 3% of GVA in an attempt to catch up with leading nations such as Sweden, Finland, the US and Japan.

FIGURE 3.2 GDP PER CAPITA, US\$ (2014) VS. TOTAL R&D EXPENDITURE AS A PROPORTION OF GDP

SOURCE: OECD, EUROSTAT, ONS, UUEPC

NOTE: UK:NI GDP ratio calculated from Regional Accounts for GDP per capita and applied to OECD data.

UK:NI R&D expenditure ratio calculated from Regional Accounts for GDP per capita and ONS data for R&D as a % of GVA



3.2.3. Addressing economic challenges

The Knowledge Economy can play a key role in growing the private sector. A larger Knowledge Economy will help to rebalance the NI economy towards higher productivity sectors that generate wealth from outside NI and sustain highly paid jobs. These companies have relatively large downstream effects as they make purchases in NI through their supply chain and employees will spend wages on a range of goods and services. Therefore, the Knowledge Economy can also benefit a range of other sectors. In addition, increased levels

of economic activity will result in a broader tax base, which can then be used to fund public services. It is also more difficult for many emerging nations to compete on the basis of Knowledge in the way that they can with cost and therefore NI has a comparative advantage. New ideas and knowledge can also be responsible for creating new opportunities, products and firms as well as wealth, which can improve economic wellbeing in its broadest sense and increase quality of life.

3.3 NI ECONOMIC CONTEXT

3.3.1. The outlook is becoming more challenging

The NI economy enjoyed relatively strong growth during 2014 as increasing consumer and business confidence and lower oil prices helped to boost demand. UUEPC forecasts for 2015 predict that growth will remain relatively positive as consumer and business confidence is buoyant and the full impact of austerity is yet to be felt in NI.

In the UK, the newly elected Conservative Government remains committed to its austerity plan, the impact of which is expected to feed through to lower rates of economic growth in NI in the medium term.

TABLE 3.1 FORECASTS FOR KEY ECONOMIC INDICATORS¹

SOURCE: UUEPC ECONOMIC OUTLOOK, SPRING 2015

	2015	2016	2017	2018
GVA growth rate	1.9%	1.1%	1.0%	1.3%
Unemployment rate	4.3%	4.4%	4.5%	4.9%
Employment growth rate	0.7%	0.6%	0.4%	-0.2%
House price growth	7.1%	5.7%	5.6%	5.5%

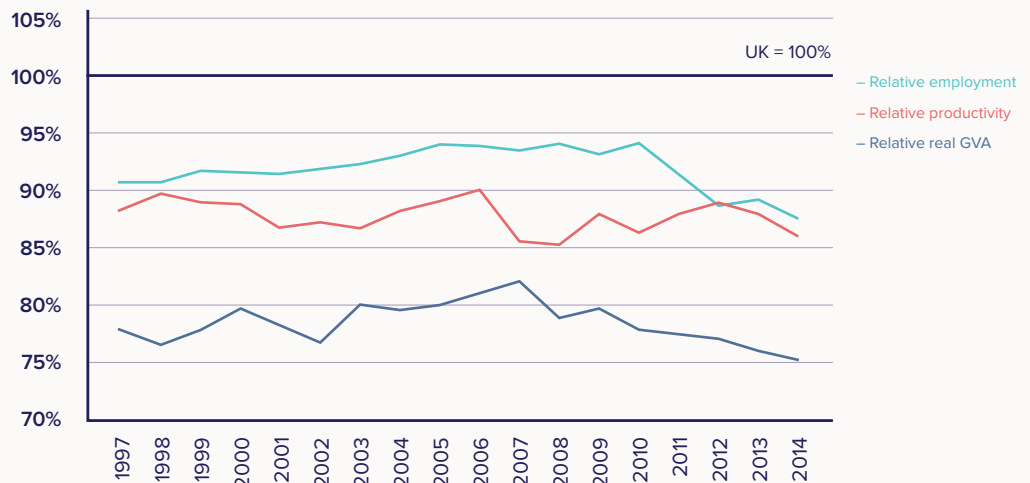
The key economic challenge for NI is to catch up to UK average levels of wealth. Lower average levels of wealth are driven by lower employment rates (relatively fewer people in employment) and lower productivity (workers producing less per hour) and a lower concentration of high productivity sectors.

These issues have been persistent for many decades and a number of economic strategies have aimed to boost the economic fortunes of NI by boosting productivity, creating jobs and securing export sales.

FIGURE 3.3 NI RELATIVE GVA PER CAPITA, PRODUCTIVITY AND EMPLOYMENT RATE, UK =100%, 1997 - 2014

SOURCE: ONS, UUEPC

NOTE: Employment is based on workforce jobs measure



¹ <http://www.business.ulster.ac.uk/epc/docs/EPC%206-pager%20low%20res%20V2.pdf>

3.4

THE KNOWLEDGE ECONOMY INDEX PROJECT

Now in its fourth year, the Knowledge Economy Index (KEI) project provides a barometer of the relative health and progress of the sector in NI, the UK regions and the Republic of Ireland from 2009-15.

The NI Knowledge Economy indicator framework is based on the San Diego CONNECT model, which is both entrepreneurial and private sector focussed. A total of twenty

one indicators make up the framework under the sub-headings of core indicators, investment, R&D and innovation & patent activity.

3.4.1. The origin of the NI Knowledge Economy project

During 2011 NI Science Park (NISP) CONNECT worked with Oxford Economics to define the Knowledge Economy, create the 21 indicator framework and develop aspirational targets to set the vision for what a successful Knowledge Economy could be in 2030. The research assessed the health of the Knowledge Economy using the indicator framework and progress towards targets.

3.4.2. Creation of the Knowledge Economy Index

UUEPC developed the Knowledge Economy Index (KEI) for NI and the UK in 2012, drawing together the indicators in the NISP CONNECT framework. The Index provides an annual assessment of the relative health of the Knowledge Economy within a single tool and calibrates the scale of the challenge for NI to catch up to UK levels. Interestingly, the research found that the NI Knowledge Economy was growing much more rapidly and catching up with the UK, albeit from a small base. The KEI was adopted by DETI as one of the independent measures of progress in the NI Innovation Strategy² underlining its usefulness as a key barometer for the sector.

3.4.3. Development of regional Knowledge Economy indices

During 2014, KE indices were constructed for each of the UK regions. These regional KEI's allowed a comparison of NI's relative progress against other parts of the UK, revealing that NI Knowledge Economy was the second fastest growing of the UK regions, improving its relative position from twelfth to tenth over a period of just five years. They also helped to identify regions from which lessons could be learned and applied to NI.

3.4.4. A new perspective for 2015

This year a range of new indicators are included that were not previously available, including Knowledge Economy GVA, productivity, wages, exports and maps of the location of firms. The inclusion of this data enables an analysis of the spatial impact of the Knowledge Economy, the calculation of multiplier effects and an assessment of its wider impact on the NI economy, providing a new perspective on the overall contribution of the Knowledge Economy to NI.

² <http://www.detini.gov.uk/innovationstrategyni>

Precision Processing Services Ltd (PPSL)

Based in Derry~Londonderry Precision Processing Services Ltd (PPSL) has developed a pioneering, environmentally-friendly chemical alternative to current solutions of removing polymeric resinous materials from industrial equipment.

PPSL specialises in the thermochemical removal of contaminants and other unwanted material from process equipment for a wide range of industry clients from the oil and gas, polymer, chemical, utility, aerospace, pharma and food sectors.

One polymeric material, which PPSL has more than ten years' experience in processing is PVB, used as an interlayer in architectural and automotive glass. However, the solvent used for PVB stripping is complex to process and dispose of due to its hazardous nature, as well as being expensive and difficult to procure.

PPSL wanted to increase their PVB stripping market by innovating an alternative, more viable solvent that was more efficient to process, more cost-effective to procure, more environmentally friendly, less hazardous and easier to dispose of.

Through the Knowledge Transfer Partnerships programme, PPSL worked with Ulster University academics Dr Paul Joseph, School of the Built Environment; Professor Tony Byrne, Faculty of

Engineering; and Dr Norry McBride, Ulster University Business School to develop a pioneering, environmentally friendly chemical alternative to removing polymeric resinous materials from industrial equipment.

As a result of the collaboration a viable alternative solvent blend was successfully developed and tested and proven to be effective with significant results: it was more environmentally friendly, with possibilities of recovery of both the solvent and the removed polymer operated at lower temperatures (saving energy and cost) simplified the overall production process.

The new substitute solvent will enable PPSL to grow its PVB business while providing a critical value-added benefit to customers in terms of its 'greener' credentials. The opportunity to recover polymer is a unique selling point in this market.

Early signs indicate that the new process will generate over a 50% increase in net profit and over a 70% increase in operational efficiencies.

The Knowledge Transfer Partnership with Ulster University has introduced a new forward-looking culture. Risks to the business in using out dated solvents have been alleviated and plant capacity has increased due to quicker processing times and shorter process operations.

PPSL has become proactive in on-going R&D for future product development. The new R&D knowledge and capability and fully functional research laboratory facilities will enable future Lab and pilot plant research projects to establish the company as a leading innovator in the industry.

4.1 HOW MUCH DOES IT CONTRIBUTE TO THE NI ECONOMY?

The Knowledge Economy is an important component of the NI economy:

- £17 out of every £20 of sales are made outside NI;
- Paying more than one and a half times the NI average wage;
- Generating a productivity premium of 45%; and
- Employing almost 10% of employees and generating more than 10% of GVA, directly or indirectly.

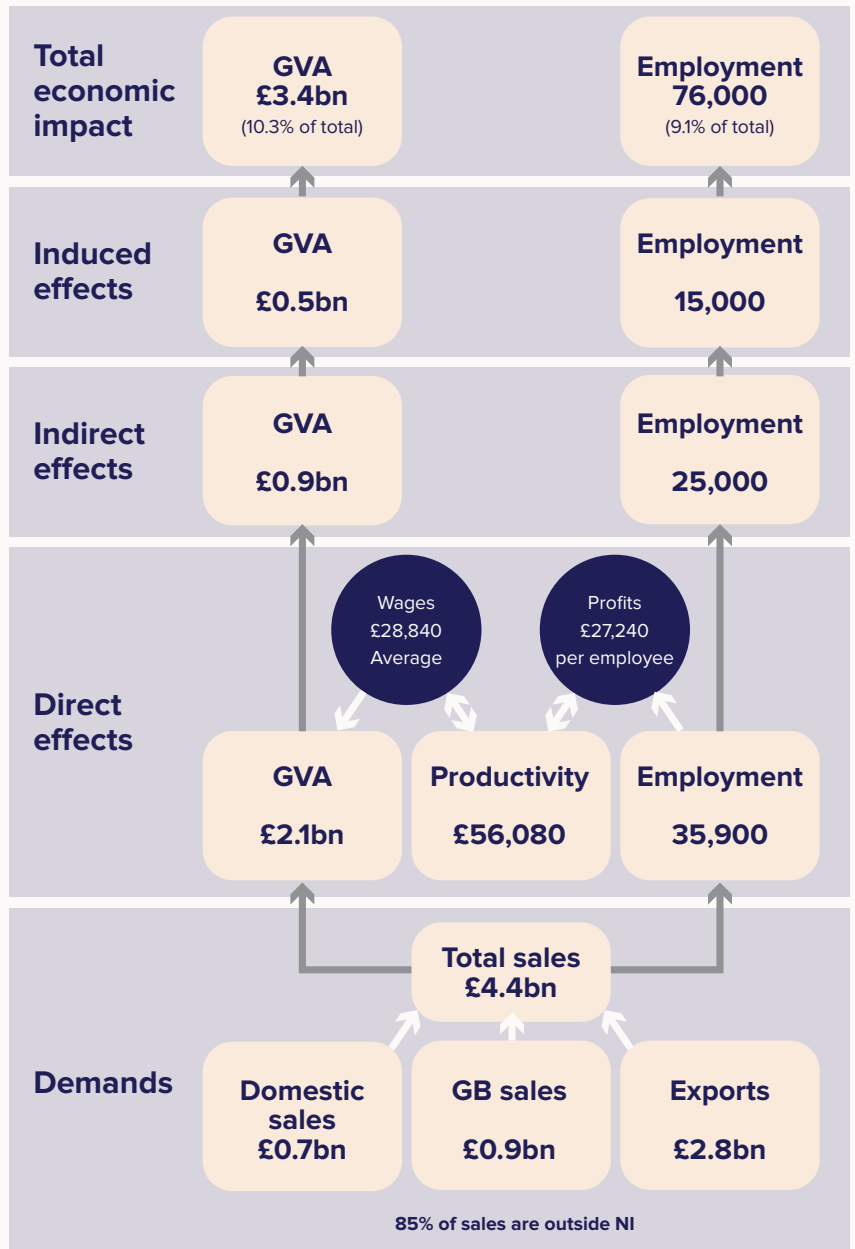
Figure 3.1 illustrates the overall economic impact of the sector.

FIGURE 4.1 ECONOMIC CONTRIBUTION OF THE KNOWLEDGE ECONOMY TO NI

SOURCE: UUEPC, NI ANNUAL BUSINESS INQUIRY (2013 DATA), ANNUAL SURVEY OF HOURS AND EARNINGS (2014 DATA), BROAD ECONOMY EXPORTS MEASURE (2012 DATA), NI INPUT OUTPUT TABLES (2008).

NOTE: Finance & Insurance is not included in the ABI. Therefore, productivity is estimated from Regional Accounts GVA and Census of Employment. These productivity estimates and employment data are then used to estimate GVA for hi-tech financial services. It should be noted that this method is conservative, using the overall sectoral average, and the hi-tech element is likely to generate higher levels of productivity and GVA.

ABI employment is used to ensure that employment, productivity and GVA align. However, the Census of Employment is the preferred measure for employment.



4.1.1. Growing employment

KE employment now stands at 37,599 having grown by 12.8% since 2009. The sector now makes up 4.6% of total employment, improving its regional ranking from 11th to 10th since the birth of the Knowledge Economy project in 2009.

For context, the number of employees in the Knowledge Economy is greater than the total employed in “Food service and Beverage activities” (32,948), which includes restaurants, takeaways, mobile takeaways, catering companies, pubs and clubs.

FIGURE 4.2 KNOWLEDGE ECONOMY EMPLOYMENT AS A % OF TOTAL, SELECTED YEARS

SOURCE: CENSUS OF EMPLOYMENT (NI), BUSINESS REGISTER AND EMPLOYMENT SURVEY (GB REGIONS)

NOTE: CoE and BRES are the preferred measures of employment.



4.1.2. High wages – and growing

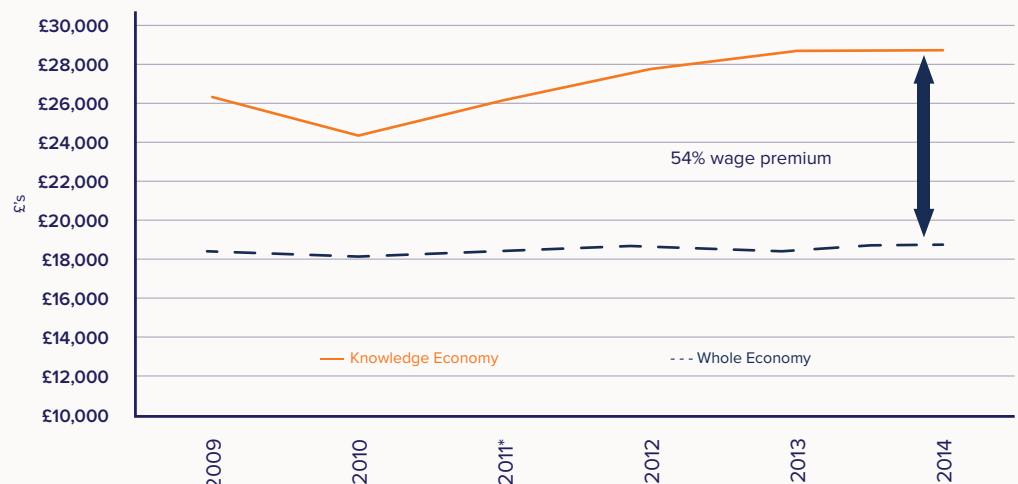
Employees in the sector enjoy a significant wage premium, earning more than one and a half times the NI average. The relatively high wage reflects the skills and knowledge that are required to work within the sector. In addition, the average

Knowledge Economy wage grew by 1.8% per annum from 2009-14, while the whole economy average grew by just 0.5%, illustrating the relative buoyancy of the sector during a challenging period for the NI economy.

FIGURE 4.3 MEDIAN AVERAGE WAGE, NI ECONOMY AND KNOWLEDGE ECONOMY, £'S, 2009 -14

SOURCE: NI ANNUAL SURVEY OF HOURS AND EARNINGS, UUEPC

NOTE: * The introduction of methodological changes to improve the quality of ASHE data has resulted in discontinuities in data.



4.1.3. High productivity³

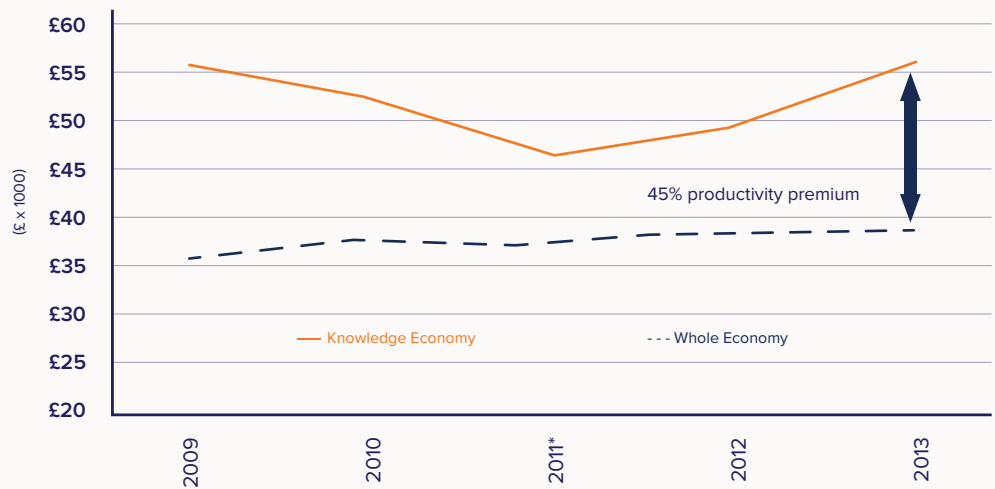
Productivity, or how much an employee can produce matters a great deal in economic development terms. If every employee produced 20 per cent more per day, they could feasibly increase their wages by a fifth, or take one day a week off without reducing their pay.

The Knowledge Economy generates a productivity premium of 45% relative to the whole economy average. A reduction in KE productivity was recorded following the recession, but is has now returned to 2009 levels.

The productivity pattern is particularly interesting as, when combined with the evidence provided by the employment and wage data, it suggests that firms took lower profits during 2010 and 11, rather than reducing employment or wages. This pattern suggests that firms within the sector were able to work through a period of lower profits in the knowledge that demand would return as their target markets picked up after the recession.

FIGURE 4.4 PRODUCTIVITY IN THE KNOWLEDGE ECONOMY (GVA PER EMPLOYEE), 2009-13

SOURCE: NI ANNUAL BUSINESS INQUIRY, UUEPC



4.1.4. Generating wealth from external sales

Exports⁴ and sales to GB are particularly important for small open economies such as Northern Ireland as they generate wealth from outside the region. **The Knowledge Economy is very much externally focused, with seventeen out of every twenty pounds of sales generated outside NI.**

Knowledge Economy firms made £3.7bn of sales outside the NI economy during 2012 (£2.8bn of exports and £0.9bn of sales to GB). It is noteworthy that 4.4% of firms are in the Knowledge economy and they employ 4.6%⁵ of all employees, yet they are responsible for almost one third of exports from NI and a fifth of external sales demonstrating

just how outwardly focused the sector is. Figures are not yet available for the import content required to produce these exports, and therefore it is not possible to report on the net impact of these external sales.

The introduction of the new Broad Economy Exports (BEE) measure by NI Statistics and Research Agency (NISRA) has significantly improved the coverage and quality of export data, especially for service sectors. This is a welcome and important step forward in reporting on the impact of the Knowledge Economy, as it comprises of a mix of service and manufacturing sectors.

³ Productivity is defined as GVA per employee. As a rough guide, GVA is made up of wages and profits.

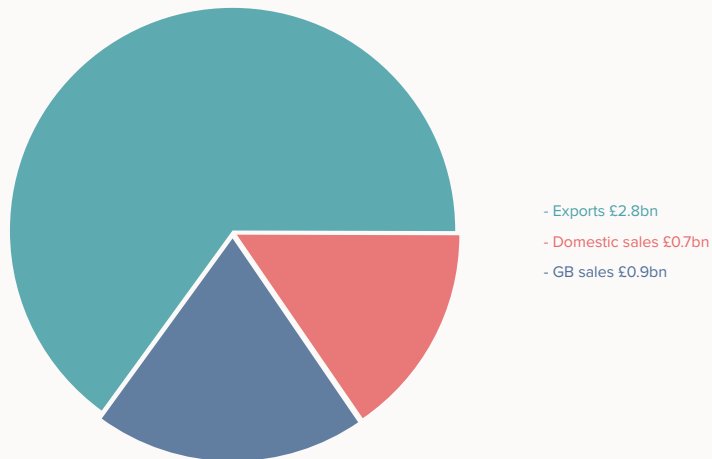
⁴ Exports are defined as sales outside the UK. Exports plus GB sales equals external sales

⁵ Workforce jobs measure

FIGURE 4.5 EXPORTS, GB SALES AND DOMESTIC SALES BY KNOWLEDGE ECONOMY COMPANIES, 2012, £BN.

SOURCE: BROAD ECONOMY EXPORT MEASURE, UUEPC

NOTE: The Broad Economy Export is based on ABI data and therefore excludes the Financial Services sector, including high tech financial services.



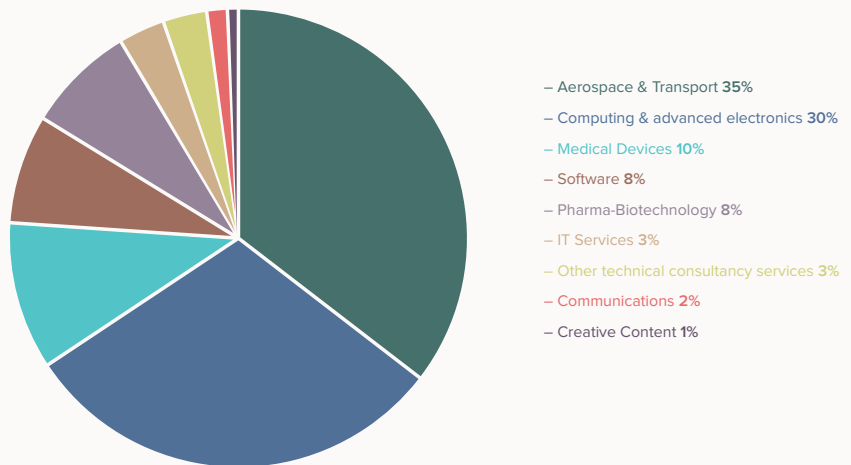
Within the Knowledge Economy, Aerospace & Transport and Computing and Advanced electronics are the most externally focussed sectors, with roughly one third of external sales

each and the remaining seven sectors accounting for the remainder.

FIGURE 4.6 KNOWLEDGE ECONOMY EXTERNAL SALES, SHARES BY SECTOR, AVERAGE OF 2011 & 2012.

SOURCE: BROAD ECONOMY EXPORTS MEASURE, UUEPC

NOTE: The BEE is based on ABI data and therefore excludes the Financial Services sector, including high tech financial services. Therefore, the total value of recorded external sales from the Knowledge Economy sector would be greater if this data were available.



4.1.5. Rebound in Gross Value Added (GVA)

Knowledge Economy GVA recovered to 2009 levels by 2013, both in terms of total value (£2.1bn) and as a proportion of NI's total GVA. Employment, wages and productivity remained relatively stable following the recession, although profits dipped resulting in lower GVA in 2010 and 11. In real terms

(taking into account the impact of inflation,) the sector is smaller than in 2009, although it is encouraging to note the upward trajectory of the most recent data, as profits in the sector begin to rebound.

FIGURE 4.7 KNOWLEDGE ECONOMY GVA, £BN AND AS A PROPORTION OF TOTAL GVA, 2009-13

SOURCE: NI ANNUAL BUSINESS INQUIRY, UUEPC

NOTE: The NIABI excludes the Financial Services sector, including high tech financial services. Therefore, GVA for high tech financial services is estimated by using productivity calculated from Regional Accounts GVA and Census of Employment data. These productivity estimates and employment data are then used to estimate GVA for hi-tech financial services. It should be noted that this method is conservative, using the overall sectoral average, and the hi-tech element is likely to generate higher levels of productivity and GVA.



4.2

WHERE ARE THE KNOWLEDGE ECONOMY COMPANIES?

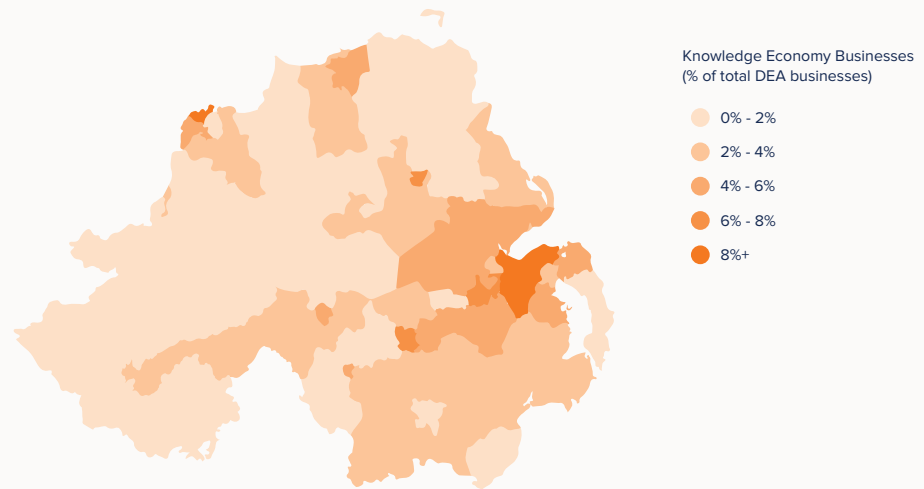
Knowledge Economy firms are mostly concentrated in urban areas, suburbs and motorway corridors, suggesting that there are benefits to the clustering and colocation for firms in the sector. Much of the sector is based in and around Belfast, which is to be expected as the capital city with a readily available skills supply and as the NI hub for external sales through the main ports and airports. Derry / Londonderry is the North Western hub, with a concentration of Knowledge Economy firms around the city.

The highest concentration of KE firms is found in the Victoria area in East Belfast, where the NI Science Park is located, with Knowledge Economy making up 13.4% of the total.

As would be expected, the lowest concentrations of KE firms are found in rural and western areas of NI, the greatest distance from main infrastructure hubs and centres of population.

Whilst the majority of the Knowledge Economy is located in and around urban areas and motorway corridors, it is also worth noting that Knowledge Economy firms are located throughout the province, helping to promote employment opportunities across NI and promote balanced regional growth.

FIGURE 4.8 KNOWLEDGE ECONOMY FIRMS AS A PROPORTION OF TOTAL EMPLOYMENT, BY DISTRICT ELECTORAL AREA, 2014



SOURCE: INTER DEPARTMENTAL BUSINESS REGISTER & UUEPC

NOTE: District Electoral Areas within Moyle, Larne and Limavady District Council areas were combined to ensure the confidentiality of potentially disclosive firm level data.

TABLE 4.1 KNOWLEDGE ECONOMY EMPLOYMENT AS A PROPORTION OF TOTAL. FIVE HIGHEST AND LOWEST RANKED DISTRICT ELECTORAL AREAS, 2014

Five highest ranked areas		Five lowest ranked areas	
District Electoral Area	KE firms as a % of total	District Electoral Area	KE firms as a % of total
Victoria	13.4%	Erne North	0.6%
Laganbank	11.5%	Glenelly	0.6%
Bangor West	10.2%	Portadown	0.6%
Hollywood	9.7%	West Tyrone	0.7%
Castlereagh South	8.8%	Erne East	0.9%

SOURCE: INTER DEPARTMENTAL BUSINESS REGISTER & UUEPC

NOTE: Geographical areas are District Electoral Areas (DEA's)

4.3 THE WIDER IMPACT OF THE KNOWLEDGE ECONOMY

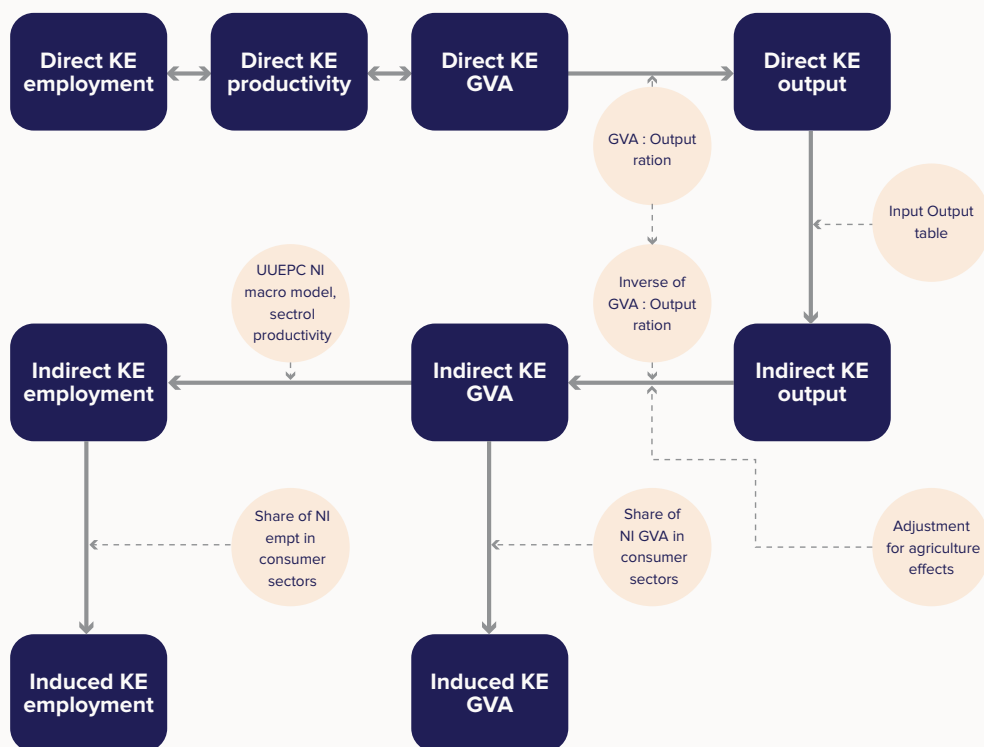
The wider impact of the Knowledge Economy is felt through the supply chain purchases made by these companies (the indirect effects) and through the expenditure of employees' wages from Knowledge Economy companies and their suppliers in NI (the induced effects).

The calculation of Knowledge Economy multipliers was possible due to the provision of sectoral GVA, productivity and employment data from the Annual Business Inquiry (ABI)

by NISRA and the use of experimental NI Input:Output tables. The multipliers were calculated annually from 2009-13. NISRA will publish updated Input-Output tables later in 2015 and it is recommended that this analysis is updated when the new information becomes available. The methodology employed to calculate NI specific GVA and employment multipliers and indirect and induced effects is detailed in figure 3.9.

FIGURE 4.9 CALCULATION OF KNOWLEDGE ECONOMY MULTIPLIERS, INDIRECT AND INDUCED EFFECTS.

SOURCE: UUEPC



4.3.1. Large employment and GVA multipliers

The analysis found that the average employment multiplier for the Knowledge Economy was 1.96 and the average GVA multiplier was 1.65 from 2009 – 13. In practical terms, this means that for every direct job within the Knowledge Economy, almost one full time equivalent job is created in the wider economy and that for every pound of GVA generated, 65 pence of additional will be generated.

These multipliers are relatively large, when compared to other sectors of the economy. The reasons are that a significant proportion of the Knowledge Economy firms are manufacturers that have significant supply chains within NI and also that average wages are relatively high in the Knowledge Economy. The result is that discretionary expenditure is relatively high, with retailers, trades and restaurants benefitting from the relatively large wage effects.

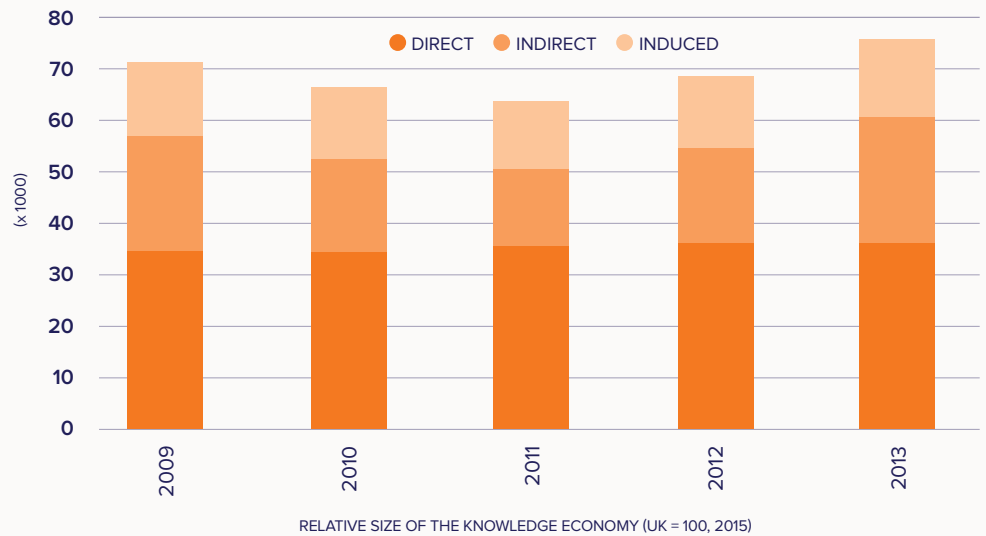
4.3.2. Almost one in ten jobs depend on the Knowledge Economy

The Knowledge Economy generated 76,000 jobs in direct, indirect and induced effects during 2013, with the result that 9.3% of NI’s employment is created as a result of the wider impact of the Knowledge Economy sectors.

Direct Knowledge Economy employment grew annually since 2009, weathering the tough economic conditions that impacted upon many other sectors. At the same time, the supply chain and wage effects compressed as competitive pressures weighed on margins, suppliers and those in the consumer sectors were less able to maintain prices and as a result employment impacts contracted.

FIGURE 4.10 KNOWLEDGE ECONOMY EMPLOYMENT IN NI DIRECT, INDIRECT AND INDUCED EFFECTS

SOURCE: NI ANNUAL BUSINESS INQUIRY, NI INPUT OUTPUT TABLES, UUEPC



4.3.3. One tenth of GVA generated by the Knowledge Economy

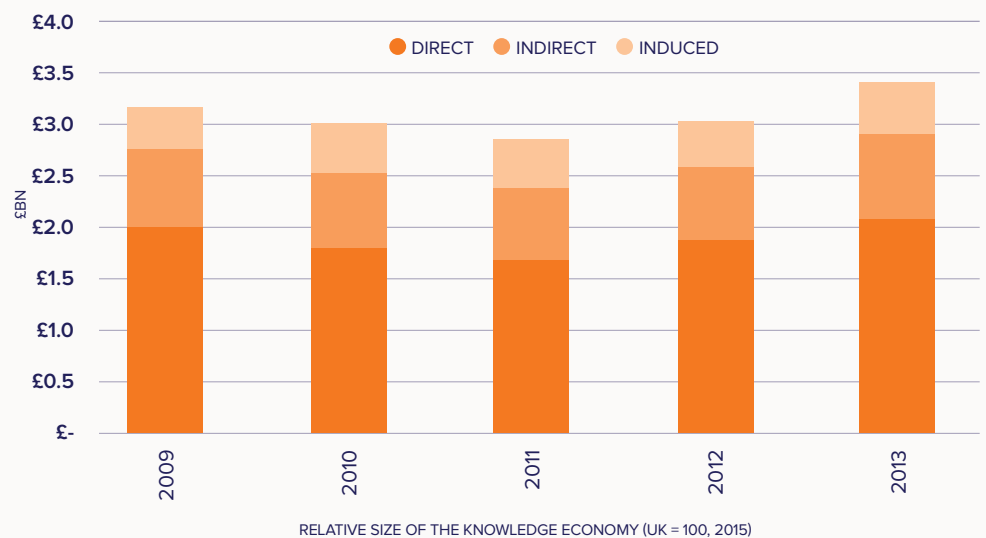
The Knowledge Economy contributed £3.4bn of GVA to the NI economy in direct, indirect and induced effects during 2013 - 10.3% of NI's total.

In the years following the recession, many sectors experienced a decline in GVA as demand in the global economy struggled to shift back into gear. Since 2011, a strong recovery has been underway with the Knowledge Economy adding one fifth to GVA.

FIGURE 4.11 KNOWLEDGE ECONOMY NOMINAL GVA IN NI (£BN). DIRECT, INDIRECT AND INDUCED EFFECTS

SOURCE: NI ANNUAL BUSINESS INQUIRY, NI INPUT OUTPUT TABLES, UUEPC

NOTE: Direct high-tech financial services GVA estimated by UUEPC using Census of Employment data and Regional accounts GVA for finance and insurance. This method is likely to underestimate as high tech financial services productivity should exceed the finance and insurance sectoral average.



4.4

THE WIDER IMPACT OF THE KNOWLEDGE ECONOMY

The Knowledge Economy is an important element of the NI economy generating roughly ten percent of employment and GVA. It is a significant source of wealth creation, with 85% of all sales made outside NI, generating wages and productivity that are around one and half times greater than the NI average.

The Knowledge Economy is clustered around Belfast and Derry/Londonderry and motorway corridors, as firms co-locate and make the most of the local infrastructure and access to the main ports and airports. The latest data demonstrates that the trends within the Knowledge Economy are, for the most part, upwards. Firms in the sector were able to sustain employment and wages during 2009 and 10, as NI emerged from the recession by absorbing lower levels of profit. Profitability has returned with firms now reaping their reward for “battening down the hatches” during tougher times.

Connected Health Innovation Centre (CHIC)

The Connected Health Innovation Centre (CHIC) is focused on business led research in the area of connected health. Based at Ulster University the centre's unique business and research collaborative approach aligns care needs with technology providers, researchers and clinical experience.

CHIC targets research in areas such as e-Health, digital health, tele-health, tele-monitoring, disease management, and home based care. The centre's academic leadership is provided by Ulster University's Professor Jim McLaughlin and Professor Chris Nugent, who bring significant expertise from their own academic disciplines. The key focuses for the research are Vital Signs Sensing Development, Integrated Care, Assisted Living, Point of Care Diagnostics and Healthcare Analytics.

It is the first of Northern Ireland's competence centres attracting £5M funding from Invest Northern Ireland for collaborative business led research with an industry led programme committee providing the direction for all work.

Its membership is made up of over 25 companies, covering a broad spectrum of Northern Ireland's health and technology sectors. Member companies such as Randox, TotalMobile, Lava Group, Ciga Healthcare, Explorisitcs,

Data Analytics Labs and Leckey come from a mixture of areas, which provides a diversity to the connected health research projects. The companies being both initiator and contributor, which also means that the research has a much stronger link to emerging market needs. In addition strong links have been developed with the local health service, which has been supported by a memorandum of understanding to encourage joint working for mutual benefit.

Some of the current thought leadership and emerging focus areas include:

- The use of emerging vital sign medical devices to improve quality of care.
- Augmented reality and virtual reality software applications to serve patients and healthcare professionals within the mobile healthcare market.
- Utilising novel sensors to understand movement and agitation in a patient's home while protecting privacy.

A core team of researchers from computing and medical engineering provide an agile method of starting and delivering research in partnership with 3+ companies. Researchers from outside the core researcher group within Ulster University and Queen's University Belfast can be utilised in line with the needs of the businesses. Each project must have a commercial direction and support from the businesses who have initiated the project. The sense of sharing of collective knowledge and challenge between the businesses and academics has been a very positive aspect of the various research projects as they iterate, change and develop to meet emerging needs or opportunities.

5 KNOWLEDGE ECONOMY INDEX

The Knowledge Economy Index is a composite indicator, comprising of data for 21 indicators from 2009-2014. Table 4.1 provides detail on the progress of each of these indicators.

TABLE 5.1 SUMMARY OF KNOWLEDGE ECONOMY INDICATORS

Knowledge Economy - Core characteristics (CONNECT definition)	Regional ranking	Ranking position since last year	Previous data	Latest data	Latest year	Sources
KE employment, as % of total employment*	10	▼ x2	4.5%	4.6%	2013	COE (NI) / BRES (GB)
KE businesses, as % of total business stock*	12	...	4.8%	5.1%	2013	IDBR
KE business start ups per 100,000 population*	12	...	17.0	22.4	2013	IDBR / NOMIS
KE median wage level	10	▼ x1	£28,721	£28,840	2014	ASHE
Investment Activity	Regional ranking	Ranking position since last year	Previous data	Latest data	Latest year	Sources
No. of private equity and VC investments (no. of companies)	11	▼ x1	38	30	2013	BVCA / IVCA / InvestNI
No. of private equity inv' per 100,000 VAT registered businesses	2	...	68	54	2013	BVCA / IVCA / InvestNI
No. of venture capital inv' per 100,000 VAT registered businesses	2	...	64	52	2013	BVCA / IVCA / InvestNI
Amount of VC investment, £M	10	▲ x2	£4.1	£6.8	2013	BVCA / IVCA / InvestNI
No. of M&A and ECM deals per 100,000 VAT registered businesses	10	▲ x1	158	183	2014	Experian Corpfin
Public listed companies: Market capitalisation per head	10*	...	£282.5	£292.4	2015	London Stock Exchange
R&D Activity	Regional ranking	Ranking position since last year	Previous data	Latest data	Latest year	Sources
R&D as % of workplace based GVA	6	▼ x1	1.8%	1.9%	2013	UK R&D Survey
Business Expenditure on R&D as % of workplace GVA	6	...	1.3%	1.3%	2013	UK R&D Survey
Business R&D personnel as % of total employment	4	▼ x1	0.6%	0.6%	2013	UK R&D Survey
No. of PhDs per million inhabitants	10	▼ x4	314	270	2013/14	HEIDI
HEI Research grants and contracts per 1,000 population	9	▲ x1	£44.4	£48.1	2013/14	HEIDI
No. of science and tech' graduates (NVQ Level 4+) as % of workforce	12	...	6%	6%	2014	LFS
Innovation and Patent Activity	Regional ranking	Ranking position since last year	Previous data	Latest data	Latest year	Sources
% of firms stating that they are innovation active	12	...	40%	40%	2012	UK Innovation Survey
No. of patent applications per million inhabitant (to EPO)	6	▲ x6	33	20	2011	OECD
No. of high technology patents per million inhabitant (to EPO)	6	▲ x5	16	7	2011	OECD
No. of patent applications filed per million inhabitant (to UK IPO)	12	▼ x1	130	122	2014	UK IPO
No. of patents granted per million inhabitant (to UK IPO)	12	...	9	15	2014	UK IPO

NOTE: * = OUT OF 10 REGIONS

5.1

DRIVERS OF KNOWLEDGE ECONOMY GROWTH

The Knowledge Economy is constructed in four pillars, three of which are activity based (R&D, investment and innovation) and a fourth, which is outcome based.

5.1.1. Research and Development activity performs well

Research and Development activity was one of the key drivers of success within the Knowledge Economy Index, with NI punching above its weight with some good mid-table performances. One indicator that provides cause for concern is the reduction in the number of PhD's per million inhabitants, which resulted in NI's regional ranking falling by four places. Future funding and policy decisions may impact upon the numbers of PhDs awarded in the medium term as potential changes in 2017 will impact upon graduations during 2020 and beyond. The economic implications however, are likely to be felt in the longer term if there are shortages of PhD graduates.

5.1.2. The flurry of investment continues

NI performed well on investment activity, with the flurry of small deals that began during 2012 continuing into 2013. The level of activity is encouraging, although in the longer term NI should aspire to numbers of larger deals and a greater number of PLCs located here.

5.1.3. A mixed bag on innovation

NI's innovation performance is mixed, with a low proportion of firms engaged in innovative activity and low numbers of patent applications and grants from the UK Intellectual Property Office. European patent activity however, was much stronger with NI posting a respectable mid-table performance, although the latest available data is 2011.

5.1.4. Core metrics

The input, or activity measures of R&D, innovation and investment activity report success in terms of increasing levels of activity and growth. Increases in activity in the pillars may take a number of years to feed through to economic outcomes measured within the core metrics element of the index. It will be important to continue to invest in these activities, both to ensure that projects underway come to fruition, but also that new and innovative products and processes take root in NI.

The outcome measures of Knowledge Economy employment, business starts, business stocks and wages have all improved over the year. However, other regions have grown more quickly, as NI moved down the regional rankings in both employment and wages, and remained lowest ranked UK regions for KE business stocks and starts.

5.2

SMALL, BUT FAST GROWING

Northern Ireland has held its position as the second fastest growing Knowledge Economy in the UK, just behind the North West, which reaped the benefit of significantly increased investment activity. The NI Knowledge Economy is ranked 10th of the 12 UK regions for the fourth consecutive year.

The rate of growth is a very positive finding for NI, as the Knowledge Economy Index has grown by almost half since 2009. It provides evidence that a large amount of activity is underway, businesses are investing and growing and the policy environment is proving conducive.

Over the most recent year for which data are available, NI moved to a lower position in the regional rankings in seven of the twenty-one indicators and improved in five, with nine remaining at the same position as last year. This most recent information suggests that conditions in the Knowledge Economy in NI are facing some challenges and as austerity based spending cuts take hold in NI over this Parliament, conditions may become more challenging.

Liopa

Winner in 2013 of the Software and Digital Media category at NISP CONNECT's 25K (now INVENT) awards, Liopa is a mobile user verification and authentication solution that uses lip movements as a unique biometric.

Liopa – lip in Irish – is an app, which is able to recognise 'visemes' and match them against database records to verify who they belong to.

"Imagine a time, before e-banking, when you could walk into a bank and, without showing your ID or passbook, the manager knew exactly who you were," says co-founder David Crozier.

"Liopa aims to make user authentication and verification as easy as that again. It's as simple as taking a selfie!"

The company is being spun out from the Centre for Secure Information Technologies at Queen's University Belfast to further develop and commercialise its research into biometrics.

Initial product development has been funded through the Technology Strategy Board's Preventing fraud in mCommerce Small Business Research Initiative.

The inspiration for Liopa stems from the fact that password security is coming under increasing pressure. One of the key problems is that passwords are hard for people to remember but are cracked easily by machines.

With a lot of financial transactions moving to mobile – an estimated \$18 trillion a year by 2018 - crime will surely follow. Nowadays, just about every smartphone and tablet comes with a forward facing camera which allows Liopa technology to be used to carry out speaker authentication.

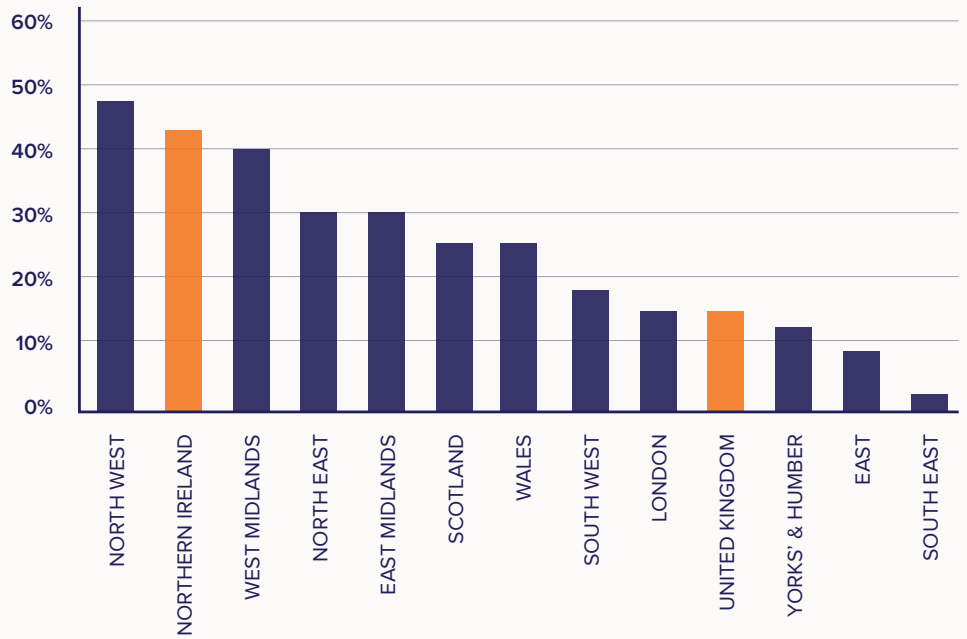
Viseme analysis has been proven more accurate than face and voice biometrics and a better indication of the 'liveness' of the person as it can't be fooled by a static image or audio playback.

Liopa has several potential applications. It can provide a verification and authentication service for preventing fraud and theft in mobile commerce transactions or used to determine user liveness on websites and mobile applications as a replacement for Captchas.

It can also be used to reduce incidences of multiple user aliases and misrepresentation within online services and other applications.

FIGURE 5.1 GROWTH IN THE KNOWLEDGE ECONOMY INDEX, UK REGIONS, 2009-2014

SOURCE: UUEPC



NI's strong performance over the last six years grew the Knowledge Economy to 73% of the UK level from a low starting position of just 56% in 2009. It also shows the scale of the challenge for NI to catch up with the UK. It will require additional growth of more than a third, underlining the scale of the challenge.

The initial stages of catching up to the UK average may be relatively easier for NI as knowledge and technology transfers, new products and processes will stand to generate more significant change than when NI gets closer to the UK average.

Oxford Economics, NISP CONNECT and key stakeholders developed a set of stretch targets for a range of Knowledge Economy indicators as part of the first phase of the Knowledge Economy project during 2012. The objectives were to;

- Articulate what a successful Knowledge Economy would look like in 2030;
- Calibrate the scale of the challenge; and
- Provide a framework against which progress could be measured.

Oxford Economics estimated that if the targets were achieved, an additional 39,000 direct jobs and £3bn of GVA would be created plus 22,500 jobs and £5bn of GVA as a result of downstream effects.

6.1 GOOD PROGRESS TOWARDS TARGETS

An assessment of overall progress reveals a positive story – the NI Knowledge Economy is ahead of the required trajectory to meet six of the eighteen targets, on target for five and below the required trajectory for seven. This is good progress towards what were designed as aspirational, or “stretch” targets in 2012.

indicator targets is good, with all four either on or above the required trajectory to meet the target in 2030. Progress in the R&D and investment pillars is more mixed, with some indicators on target, some above and some below. The performance in relation to patents is concerning, with the latest figures below what is required to stay on track to meet the 2030 target.

When the four individual areas (core, investment, R&D and innovation) are considered, progress towards the core

FIGURE 6.1 PROGRESS TOWARDS NISP CONNECT ASPIRATIONAL TARGETS

ABOVE		ON TARGET		BELOW	
Knowledge Economy bus’ startups		Knowledge Economy employess		Knowledge Economy bus’ (total)	
No. of VC inv’ (deals)	£	Knowledge Economy wage premium		VC inv’ (£m)	£
M&A and ECM activity (deals)	£	No. private equity inv’ (companies)	£	No. Public Listed Companies	£
Total expenditure on business R&D, £m		Total expenditure on R&D, £m		HEI research grants & contracts, £m	
No. R&D personnel		No. PHDs, per annum		No. Science & Tech’ grads (NVQ 4-)	
Proportion of innovation active firms		-	-	No. patent apps, per mil pop	
-	-	-	-	No. high tech patent apps, per mil pop	

Key: Core indicator Investment R&D Innovation

SOURCE: VARIOUS, UUEPC

NOTE: It should be noted that the proportion of innovation active firms appears to be above target largely due to a change in survey methodology between 2009 and 2010. Consideration should be given to revising this target when data is published on a consistent basis from 2009 – 2012.

6.2

ALIGNING TO THE INNOVATION STRATEGY

The indicators used to set targets for the Knowledge Economy also corresponds to two of the indicators employed in the NI Executive's Innovation Strategy, they are the number of Knowledge Economy Employees and the Total value of Expenditure on R&D. NISP CONNECT targets are intended as aspirational or stretch targets for 2030 and were set by an independent and largely private sector-led team with the result that they are more ambitious.

An assessment of progress towards the Innovation Strategy targets for 2025 reveal that NI is on track for both indicators, which is good news and an endorsement of the efforts of those in the sector, policy makers and educators.

SiSaf

Founded by Dr Suzanne Saffie-Siebert, SiSaf was conceived as an innovative drug delivery company specialising in the design and formulation of semiconductor delivery systems for a wide range of medical, nutrient and skin care applications.

SiSaf has developed a unique nanoparticle silicon based platform that has very broad formulation applications. The nanoparticles dissolve to Orthosilicic acid, the natural form of silicon absorbed from food. Orthosilicic acid has a positive safety and toxicological profile – it's literally edible!

Suzanne says, "Our vision is a new world where patients are at the centre of their treatment. A world where medicines are developed to suit patients' needs not the other way around."

The company has had significant investment rounds, which have allowed it to recruit and develop a team of research experts.

"Last year we obtained our human trial data for both safety and efficacy of SiSafe's anti-acne formulation", explains Suzanne.

"50 trial subjects showed no skin irritation, redness or any other side effects and the product demonstrated the highest safety. And when it came to efficacy, trial subjects showed very impressive efficacy with up to 95% acne reduction."

The company has also been developing the application of its technology to the animal health sector and during 2014, further expanded their team with two highly skilled senior managers in animal health sector. In less than a year they secured commercial partner for live vaccine in China.

Suzanne and her team are very excited about the international reaction to their technology and in the next 12 months they are aiming at maturing three deals, which are currently at an advanced stage of discussion.

"We have just signed Heads of Terms with a US based skin care company for the commercialisation of our first skin care product, an anti-acne cream, under the brand name Dr SiSaf. The product is planned to launch by 2016.

"In our animal welfare division we have signed an exclusive licensing deal with an international biotech company for use of our technology for their products primarily in feed additives. This is leading on to securing a major animal health partnership.

"We are also moving on to raising series B funding to expand the company's operational team. The future for SiSaf as a company and Dr SiSaf as a brand in the international marketplace is beyond question and we are delighted to say that we started in Northern Ireland."

Each of the organisations represented on the KEI steering group invest significant time and resource in their own particular way, to grow the Knowledge Economy in NI. The NISP CONNECT team lead the Innovation into Action process in coordination with DETI and Invest NI, both Universities produce high quality graduates, research and spinout companies. Invest NI supports new and existing businesses to innovate, research and export and the Bank of Ireland supports these companies by providing access to finance and advice.

NISPCONNECT

NISP CONNECT

NISP CONNECT is an independent, non-profit organisation at the Northern Ireland Science Park. Set up in 2008, our vision is the transformation of Northern Ireland into one of the most entrepreneurial knowledge economies in Europe by 2030. Our core purpose is to mobilise expert business community volunteers to help Northern Ireland’s entrepreneurs to create and scale fast-growth innovation companies.

Our programmes focus on helping entrepreneurs to access the skills, knowledge and resources essential to growing technology-based companies.

Support from our members enables us to:

- help entrepreneurs and innovators to form new companies with stronger founding teams: with Co-Founders Wanted!
- mentor and expose new ideas to diverse experts quickly with

Springboard, our personalized accelerator programme with over 60 entrepreneurs-in-residence, the highest quality pool of mentors ever established

- define and benchmark Northern Ireland’s progress as a knowledge economy with the Knowledge Economy Index
- inspire our young people to aspire to careers in science and technology with Generation Innovation
- give a platform for our new

entrepreneurs to learn from our most experienced entrepreneurs and domain experts with Frameworks

- send over 20 of Northern Ireland’s brightest young people to work in one year internships with some of the world’s leading corporations in the USA for one year with our US: NI Mentorship programme in partnership with Declan Kelly and the American Ireland Funds.
- help our elected officials and policy makers with our advocacy work.

Bank of Ireland UK

Bank of Ireland UK shares in the NISP CONNECT vision of a Northern Ireland that becomes famous for innovation and entrepreneurship. At Bank of Ireland UK we care and passionately believe that Northern Ireland needs more entrepreneurs and business start-ups. We understand the value of innovation and its importance right across the business spectrum in driving economic growth.

The Bank supports some of Northern Ireland's most innovative companies from start up through to global success and has made it its business to develop its partnership with NISP Connect to ensure we can support businesses whose ambitions have a global reach.

Collaborating with business and industry partners, bringing the right people together, sharing new ideas and best practices, that is what creates the environment conducive to driving innovation and growth. This partnership has meant BOI UK has taken on an important leadership role, provided support, access to and sharing of

specialist knowledge, skills and expertise from within its business.

This has included:

- representation at Board Level and across the breadth of NISP Connect programmes
- getting our staff involved at all levels with provision of mentoring, market & funding insights, general business support and leadership
- acting as a strong advocate in engagement with Public Sector and Private Sector groups.

Bank of Ireland UK sees its role as important not only in terms of

the financial support, but more so through the commitment of its team in understanding innovation and technology entrepreneurs. Our people are passionate about helping businesses to realise their potential. We're committed to being Northern Ireland's 'Enterprise Bank' and to providing innovative and competitive solutions for our customers as they work to succeed in a global market.

For Bank of Ireland UK it's about our people working hard to understand our customers, their business needs and become a valued partner.

Ulster University – investing in the Knowledge Economy

Ulster University works to cultivate the innovation, creativity and entrepreneurial spirit of students, staff and key partners to shape confident careers and encourage opportunity in a vibrant economy.

We work closely with local business to identify early the needs of industry, ensuring we produce the high quality graduates with the work-ready skills required to meet those needs. Our graduates are enterprising and innovative, with many creating products that sell all over the world, generating revenue, jobs, wages and ultimately, economic growth.

We work collaboratively with companies of all sizes, locally and globally, helping them to access the knowledge, ideas and solutions that will allow them thrive and reach their economic potential. In the last year alone, we worked with over 5,000 companies to deliver innovative solutions for industry. Over the past five years we have established 18 spin-out companies -- flourishing businesses delivering a turnover of around £26.5m and employing more than 200 staff in

the local economy. Ulster University was in the top 10% of UK universities for the number of patents it was granted in 2013/14.

Our research delivers real outcomes that inform policy and shape growth and opportunity. International experts have independently judged Ulster University to be in the top 25 per cent of all UK universities for overall research and in the top third for research impact, with 72% of our research activity considered to be world leading or internationally excellent. Our performance in the 2014 Research Excellence Framework ensures that we are truly significant and influential on the national and international stage.

Ulster University is ambitious for its students and for Northern Ireland. We are at the heart of the economy,

providing the opportunity to turn pioneering ideas into marketplace reality. From partnerships that break new ground, to course development, Ulster University is proud to be future thinking.

Professor Paddy Nixon, Vice Chancellor, Ulster University

“Ulster University’s collaboration with business and industry explores possibilities and drives solutions. It’s a meeting of minds – exchanging ideas and sharing expertise. We play our part in the development of local business – from start-up and early stage companies to those with fast growth export potential. Partnership with the highly skilled and vibrant knowledge economy fosters the innovation and enterprise so essential to Northern Ireland’s local and global opportunity.”

Invest NI – The Knowledge Economy 2011-12 to 2014-15

During its 4 year period, Invest NI provided 3,382 offers to businesses within the Knowledge Economy. These amounted to £222m of financial assistance, and contributed towards £1,162m of planned investment within the sector.

This support represented 36% of Invest NI's total assistance over the period, and 34% of total investment.

These offers have the potential to create over 6,000 new jobs and result in gross annual salaries of over £174m.

Over the period the amount of assistance offered to businesses in the Knowledge Economy increased by 145%; investment and annual salaries also increased by 156% and 100% respectively. Job promotion increased by 116% from 1,005 jobs in 2011-12 to 2,169 in 2014-15.

The gross average salary of companies receiving Selective Financial Assistance (SFA) within the Knowledge Economy was £30,721. This is 21% higher than supported jobs within other sectors.

Queen's University Belfast – The Knowledge Economy

Queen's University Belfast plays a critical role in the growth of the regional knowledge economy. Innovation, research and discovery at Queen's and a suite of commercialisation activities arising from these make a valuable contribution to Northern Ireland's economy.

The University's commercialisation team punches above its weight across a range of national performance indices in comparisons with over 140 Higher Education Institutions (HEI) in the UK.

Data available places Queen's as:

- The top performing university for the volume of revenue from sales of spinout company shares
- 3rd in the Russell Group for the level of IP income generated
- The HEI with the 4th highest current spinout turnover
- Among the top ten HEIs too for the number of new patent applications, patents granted and the cumulative total of patents in its portfolio.

Via QUBIS Ltd, Queen's has to date invested in 68 spinout ventures, with a collective turnover of £190m, creating employment for almost 1,600 people,

mainly skilled graduates, and securing in excess of £75 million external investment.

Queen's is also known as the UK's leading HEI for KTPs, working with businesses, mainly local SMEs, to improve their competitiveness and productivity through the exchange of knowledge, technology and skills from within the University. A driving force in local wealth and job creation, KTP businesses generally achieve an annual increase in pre-tax profits of c£270,000.

Other ways in which Queen's supports local companies to gain knowledge and grow include:

- the provision of consultancy services
- signposting access to Innovation Vouchers and KTPs
- helping in the licensing of intellectual property

- partnering in research collaboration activities
- offering a programme of events that provide a channel for knowledge exchange, including with leading national and international visiting speakers – and excellent networking opportunities
- the provision of high end executive education and leadership training through the William J Clinton Leadership Institute.

Queen's will continue to work with industry partners to drive the development of the knowledge economy, transforming Northern Ireland into one of the most entrepreneurial knowledge economies in Europe by 2030.

See.Sense

Founded in April 2013 by Northern Ireland based husband and wife team Philip and Irene McAleese, See.Sense is a leading global cycling technology company known for their innovative use of advanced sensor technology. In the same way that smart sensor technology transformed the humble mobile phone into connected devices with huge capability, See.Sense are doing the same for cycling accessories. As an innovative cycling technology company, See.Sense is ideally positioned to capitalise not only on the growth of the cycling market, but also the mega-trends in IoT, mobile apps, data and the quantified self movement.

Their first product is See.Sense – an intelligent bicycle light that uses patent-pending, advanced sensors to monitor the cycling environment. The sensors allow the light to react to dangerous situations, where most accidents occur - such as road junctions and filtering in traffic, approaching car headlights at night, the entry and exit of road tunnels and more. The See.Sense light flashes brighter and faster only when needed, its intelligent power usage allows it to be smaller and lighter – without the need for heavy and inconvenient external battery packs. It offers a level of brightness and runtime unmatched by any light of the same size and weight.

See.Sense launched on the crowdfunding platform Kickstarter in October 2013. In 31 days, they raised £33, 826 from over 500 backers who bought more than 850 lights. See.Sense went on to capture the imagination of journalists around the world, and received coverage in The New York

Times, The Guardian, Spiegel Online, Stuff, as well as leading cycling and technology magazines around the world.

See.Sense, which is designed and manufactured in Northern Ireland, is now stocked with Chain Reaction Cycles, the world's largest online bike store and also sells into more than 45 countries around the world direct from its own website. Additionally, See.Sense is stocked in over 45 independent bike shops across UK and Ireland, as well as Belgium, Mexico and Australia and is listed with Google's staff perks scheme.

See.Sense are graduates of NISP CONNECT's Springboard programme and category winners in the INVENT Awards 2014. Other awards include best Early Stage Company in Northern Ireland at the InterTrade Ireland Seedcorn Investor Readiness Competition (2013), UKTI/Open to Export's Global Jumpstart Competition

(2013), and Invest NI Propel Awards' Breakthrough Company of the Year (2013), Electronics category (2014), a runner-up award in the Duke of York's Pitch@Palace 2014, Women in Business Startup of the Year 2014 (Knowledge Economy), the Chartered Institute of Marketing Director's Award, 2014 and a Cycle Innovation Award from Belfast's Fred Festival. In addition, See.Sense recently won The Guardian's Small Business Network Award for Marketing and PR Excellence.

With high growth in sales over the first two years of trading, the future for See.Sense looks bright as it now turns to the release of two innovative products, one in 2015 and one in 2016. The team has grown from two to seven, and further recruitment is planned over the coming months in 2016, See.Sense will have a very global focus, seeking to further grow the brand internationally.

8.1

A VITAL SECTOR OF THE NI ECONOMY

The Knowledge Economy is a vital sector of the NI economy. It generates significant income from sales outside NI, helping to grow the economy and create well paid and highly productive employment opportunities.

The majority of companies in the sector are clustered in and around Belfast and a North West Knowledge economy hub also exists in Derry/Londonderry. Whilst the majority of the firms are located in and around the cities and along motorway corridors, there is also an even spread across rural areas, providing employment opportunities and helping to promote regional growth. The downstream effects mean that jobs are created in sectors such as retail, hospitality and construction as Knowledge Economy companies purchase from their suppliers and employees spend their wages.

The Knowledge Economy Index demonstrates that the NI Knowledge Economy is the second fastest growing in the UK and is ranked 10th of the UK regions. The most recent data shows that NI moved down the regional rankings in seven of the indicators and improved in five. The challenges will be to boost KE activity at a pace that exceeds other regions and then to translate this activity into economic outcomes in terms of employment and wage growth.

8.2

THE ECONOMIC CHALLENGE FOR NI

Northern Ireland has for many decades sought to increase employment rates and productivity levels to equal the UK. Encouragement can be taken from very good R&D and investment performances as NI ranks mid-table in many of the indicators. Therefore, it is possible that with sustained investment, NI can move up the regional rankings.

8.3

HELPING NI BECOME MORE FISCALLY SUSTAINABLE

The Knowledge Economy will be important in helping to rebalance the NI economy. Growing a larger private sector is important. However, growing a highly productive and externally oriented private sector should be the ultimate goal, generating wealth from outside, creating sustainable jobs with high wages and disposable income that can be spent locally. Increased economic activity will result in a deeper and broader tax base, which can then be used to fund public services.

8.4

OFFSETTING AUSTERITY – THE KNOWLEDGE ECONOMY IS CRITICAL

Austerity will begin to impact upon the NI economy during 2016 and beyond. Reductions in public spending it would seem, are inevitable and therefore a plan of action should be in place to ensure, in this context, that the policies and programmes that deliver for the Knowledge Economy provide the best level of value and are funded appropriately.

Commentary from our universities

On the critical role of Higher Education in driving Northern Ireland's Knowledge Economy

- Investing in our young people - i.e. our human capital – is critical for the long term success of Northern Ireland and vital in building a Knowledge Economy that is globally competitive.

- Stopping the “Brain Drain” within Northern Ireland. In addition to already being a huge exporter of talent, the region will not be a magnet to attract non-NI domiciled undergraduate and postgraduate students, given the uncompetitive position of our two universities. To illustrate, Scotland invests heavily in developing its Knowledge Economy and is a net importer of global talent. A commitment to sustainable funding for our universities is vital.

- Improving educational attainment at school level to substantially increase the pipeline of skills and talent available to fuel the Knowledge Economy. This is hugely important for the long-term sustainability of a competitive NI Knowledge Economy.

- The importance of long-term investment at postgraduate level within Higher Education should not be underestimated. PhD researchers are especially valuable to R&D active firms and are one of the most effective methods of providing knowledge transfer between academia and industry. Postgraduate researchers can enhance the absorptive capacity of knowledge intensive firms, bringing with them new knowledge, working methods, a personal network and an ability to solve complex problems

Titan IC

Titan IC Systems, as the name suggests, was born and bred in Belfast, where it spun out from the Institute of Electronics, Communications and Information Technology (ECIT) at Queen's University Belfast.

The company offers a portfolio of network and network security related intellectual property based on research conducted at ECIT and expertise in the wider Northern Ireland area.

Research has focused on the underlying processing architectures and silicon technologies essential for supporting secure, high quality streaming services.

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.

Typically, the job of filtering internet traffic for malware and analyzing big data sets is performed by racks of servers and software. TitanIC has created a hardware solution specifically customised to do the same thing at far less expense of money and energy.

TitanIC innovation lies in the ability to perform fast and parallel pattern matching and regular expression processing at speeds of up to 40Gb/s - easily enough to filter all the content coming into a city like Belfast!

The same level of processing usually requires the commitment of many servers running dedicated software. But a single Titan IC board, being tailored for the task, costs a fraction both in terms of money and energy.

Application areas include: Intrusion Detection, Intrusion Prevention, Anti-Virus, Anti-spam, Stateful Package classification and Content URL/Filtering.

The company's recent product launch is Hyperion - a versatile PCIe-based network processing solution for demanding cyber defence, network and cloud security appliances. Highly optimised for complex flow and content processing tasks, it's targeted

at security appliances requiring sophisticated rule based packet inspection.

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. This could even be extended in the future to the high speed analysis of the human genome.

The first customers to take on TitanIC custom solution have been multi-national tech firms in Silicon Valley and the team hopes to grow the company to many millions in annual revenue as a custom solution, configuring each board to the customer's specific needs.

The Knowledge Economy is a key contributor to the health and wealth of the broader NI economy. A vibrant sector will help to boost levels of economic activity, which in turn will help to strengthen the tax base from which public services can be funded.

9.1
ASPIRE TO EXCELLENCE

A decade ago, many would have found it difficult to believe that NI could equal the UK in terms of R&D intensity. NI has now caught up to the UK average level and many new, innovative products are sold from NI as demonstrated by the case studies. This success has been possible due to the collective efforts of those in the sector, educators, policy makers, delivery agents and researchers and NI should aim to replicate this success in other Knowledge Economy pillars.

Catching up to the UK average on R&D intensity could be viewed as one step on the journey to success. The target for NI could be set at 3%, aiming to catch up with countries like Sweden, Finland, the US and Japan. A resource plan for requirements from each of the stakeholders could then be

developed, identifying actions for Business, Government, Higher Education R&D participants, their funders and customers.

9.2
INVESTING IN EVIDENCE INFORMED POLICY MAKING

9.2.1. Knowledge policy matrix

A number of Departments and other Government bodies deliver policies that are relevant to the Knowledge Economy. Consideration should be given to developing a Knowledge Policy Matrix which would map out the programmes, owners, expenditure and impacts. This would allow NISP CONNECT to help inform which policies are most important to the sector on a holistic basis and inform the direction of future policy. It would also serve to help direct Knowledge Economy companies to appropriate sources of funding.

The matrix will allow the prioritisation of funding and an open discussion on which expenditure is most needed. It may be that increasing the VC deal flow is a priority, or increasing the number of STEM graduates or PhD researchers. Subsidies for innovators or tax breaks may be the priority – but either way the most important investments must be identified and prioritised.

9.2.2. Updating wider economic impacts with new data

Growing the Knowledge Economy benefits a range of sectors across the economy as demonstrated by the multiplier effects reported earlier. NISRA will publish updated Input:Output

tables for NI later in 2015 and it is recommended that the analysis is updated with the new information to obtain a more accurate assessment of the overall contribution of the sector.

9.2.3. Broadening the reach of existing surveys

NISRA have made significant advances in the provision of Knowledge Economy data through the development of the Broad Economy Exports measure and release of previously unavailable wage, productivity and GVA data. Their investment in Input:Output tables will mark another step forward later in 2015.

A slight weakness of the ABI and Broad Economy Exports Measure is that Financial Services and Insurance is not included in the survey (this is the case in both the UK and NI and is part of the survey design). If this sector were to be included, it would be of significant benefit for policy analysis and advice, especially if a lower rate of Corporation Tax is implemented in NI.

9.2.4. Extending the Knowledge Economy Index

GVA, productivity, exports and wage data for the NI Knowledge Economy has been included for the first time in this report. For the next iteration of the Knowledge Economy Index, the data should be gathered for the other 11 UK regions. This will allow the incorporation of the indicators into the Core Indicator element of the KEI, which will augment the coverage of the index.

9.2.5. Matched study with San Diego

Given the genesis of the programme in San Diego, a matched firms study would be particularly valuable for NI. It would help a great deal to understand how differences in management practices, behaviours and cultures impact and how companies could adopt better practices in order to grow the Knowledge Economy in NI.

9.2.6. Venture capital and funding for innovative start-ups – time for an official survey

There is no single source that captures and reports on all venture capital activity for NI which presents significant issues in terms of measuring activity and developing effective policies. There are also sources of finance that are being used by companies in NI, such as crowdfunding and halo investment that are not reported within official surveys. It will be important to understand how innovative start-ups and growth companies are funded, if companies struggle to secure appropriate finance and how that part of the market is evolving. It is recommended that primary research is carried out on financing innovative start-ups and growth companies.

9.3

CONSIDERING LONGER TERM INVESTMENTS IN THE ECONOMY

The next five years are set in the mould of austerity, with the newly elected Conservative budget remaining firmly committed to reigning in public expenditure and maintaining the tax base. In this environment, additional scrutiny of policy and expenditure decisions will be inevitable as officials strive to maximise Value for Money. The proposed Knowledge Policy Matrix, if developed, will help to inform longer term investments, as it is inevitable that not all desired projects and programmes will be funded.

Innovative solutions will be required and it is likely that alternative options for funding will need to be examined, including bursaries, sponsorship from profitable Knowledge Economy companies, philanthropic donations from some of NI's successful knowledge economy entrepreneurs, overseas funding, increases in other taxes such as rates or reductions in other expenditures.

9.3.1. Skills for the future

Recent reductions in the Higher Education budgets attracted significant attention locally. During a time of austerity, all areas of Government expenditure should be reviewed to ensure that budgets are being spent efficiently and effectively. How these reductions are managed within the sector is just as important and maximising research income from other sources, such as the EU, safeguarding courses that provide the skills that are required by existing and potential future Knowledge Economy employers and investing in PhD graduates will be particularly important. A new approach may be required in order to fund some of the skills that are

required - the Knowledge Economy is a profitable sector and the baton may pass from Government to the private sector, at least in part.

9.3.2. Corporation Tax

The implementation of a 12.5% rate of Corporation Tax in NI to match the rate in the Republic of Ireland has been the subject of significant debate in recent years. A lower rate should benefit the Knowledge Economy in a number of ways. Firstly, it should increase the inflow of FDI, much of which is expected to be in Knowledge Economy sectors, such as hi-tech manufacturing and Professional, Scientific & Technical services. Secondly, some existing companies within the Knowledge Economy will have a reduced tax bill, leaving them with more to invest in their businesses and employees as the policy represents a transfer of resource to the private sector. Knowledge Economy advocates should support the implementation of a lower rate in NI.

9.4

ON THE CORRECT PATH

The Knowledge Economy has made excellent progress since the birth of the Knowledge Economy Project in NISP CONNECT in 2011. The KEI demonstrates that the Knowledge Economy is almost one third larger than in 2009 and, whilst it is still ranked 10th of the UK regions, it has made good progress towards catching up to UK levels.

The new export, GVA, wage and productivity data demonstrates just how important the sector is; responsible for ten percent of employment and GVA and selling £17 out of every £20 outside NI. An assessment of progress towards NISP CONNECT's aspirational targets shows that two thirds are on, or above the trajectory required to meet the target.

The environment is set to remain challenging over the next few years. The Knowledge Economy was able to weather the storm that followed the recession in 2008, due, in part, to the fact that a large proportion of sales are outside NI. The outward looking nature of the sector will be a key strength during a time of austerity and will help the sector to continue to deliver on the NISP CONNECT and Innovation Strategy targets.

Innovation into Action

Following the launch of the NI Executive's Innovation Strategy in September 2014, NISP CONNECT Chair, Chris Horn, wrote to Enterprise Minister Arlene Foster offering the services of NISP CONNECT to convene Northern Ireland's main Knowledge Economy stakeholder organisations to facilitate a process to identify further ideas of private sector action and government policies that can drive the required growth to which we all aspire. Minister Foster welcomed the "Innovation into Action" offer to build the good work of the Innovation Strategy.

Between March and June 2015, NISP CONNECT invited over 50 industry organisations, networks, meetUps and trade associations to nominate their most "can do" members to participate in a process to collectively and collaboratively figure out how to crack the biggest challenge standing in the way of our dream of economic transformation in Northern Ireland: "how do we change our business culture at scale?"

Through a democratic process of idea submission, debate and refinement, participants were asked to identify the silver bullets that would address the following challenges once and for all:

- How do we foster a culture of entrepreneurship, specifically on-campus at Higher Education and Further Education institutions?
- How do we crack Northern Ireland's "BMW syndrome" to increase the scale of ambition and innovation of our entrepreneurs and SME leaders
- How do we foster a culture of collaboration where local businesses and entrepreneurs collaborate to compete?

Answers were clear. A copy of the Innovation into Action report is now available, published alongside the Knowledge Economy Index for 2015.

Automated Intelligence

Belfast-based Automated Intelligence Limited (AI) was founded in 2010 when two people with different expertise and experience, CEO Mark Godfrey and CTO Simon Cole, pooled their skills to create a software solutions success story.

Their vision was to respond to a change in market dynamics by producing enterprise software solutions, which demonstrated return on investment and innovative delivery methods, such as cloud and hybrid computing.

The products are designed by an in-house team of skilled and experienced industry experts to fit seamlessly into a Microsoft environment, enabling organisations to exploit Microsoft SharePoint, Microsoft Azure and Office 365 for an enhanced information strategy. The company has a large team of Quality Assurance Engineers, who support development to ensure products reaching customers are of the highest standard, backed by the services of a local customer support team.

AI's technology solves complex information management problems for large organisations and is unique

in adopting a user-focused approach, which makes it easier for staff to do their job without worrying about organisational requirements.

After year one, which was devoted to research and development activities, the company secured one of the largest central government departments in the UK as its first customer.

That success continues, with AI now delivering information management solutions for 15 of the 24 UK Ministerial Departments, including the Ministry of Justice, Department for Education, Department of Health, HM Treasury and Department for Energy and Climate Change.

Fifty staff in Belfast and across the UK have delivered more than 100 customer solutions across the public and private sector. These include a range of councils such as London Borough of

Islington, Wiltshire Council and the City of Cardiff Council.

AI have also gone on to secure customers in other sectors and territories, including UK Healthcare, Northern Ireland Public Sector, UK Financial Services, Energy providers and the global commercial space.

They have also worked with charities supporting them in delivering an information management strategy that meets their organisational goals. These include the British Red Cross, Amnesty International and Cancer Focus NI.

AI believe their success to date has been achieved by building products that meet market demand via customer-facing teams that work with clients to understand their specific requirements and develop innovative solutions.

We would like to thank those involved in the Knowledge Economy Index Steering Group for providing their knowledge around key areas of the index, contribution to informed decision making throughout the development of the report and ongoing support for the project.

Furthermore, we would also like to acknowledge with much appreciation the crucial role of the following persons from Northern Ireland Statistics and Research Agency (NISRA) in providing the necessary data in order to enhance the report with better articulation on the impacts and demography of the Knowledge Economy;

- David Marshall
- Deborah Lyness
- Damian Buchanan
- Cathryn Blair
- Johnathan Harvey
- Robin Griffith
- Brian Spence
- Oonagh Neenan
- Victoria Maier
- Catherine Lynn

Lastly, we would like to thank Marguerite McPeake and Grainne McGinn for their contribution to the Knowledge Economy research during their placements at Ulster University Economic Policy Centre.

Plotbox

Like many entrepreneurs Sean and Leona McAllister found their business idea almost by accident following a commission for Sean as a surveyor and engineer to map a local parish cemetery.

When the construction company that provided most of his business went out of business, the couple revisited the work they had produced for the parish as a serious business opportunity when they were continuously approached to provide the service to others.

Now Plotbox is making significant inroads into the multi-billion dollar market in the US with enquiries starting to come from all over Europe. In the UK and Ireland they have built a strong client base and have been winning awards in business and innovation in both Northern Ireland and America.

Plotbox provides the most comprehensive world leading software-as-a-service for local authorities and private companies operating cemeteries and crematoria.

Not surprisingly old records are most often held in handwritten records. Historical records of grave plots are also often difficult to locate. Combining

historical records with the needs of operating a modern business that is subject to increasing legislative requirements including Health and Safety, is proving a challenge to the industry all over the world.

Through Plotbox all the disparate data points in the process of managing a cemetery can be connected in one place, accessed through an intuitive interface. The key strength of the product is geolocation. Each individual burial plot can be placed on an interactive map, and linked to all its associated information, such as family names, appointments and financial transactions.

It also provides a comprehensive management system, which can be accessed discretely by those needing professional access to the client system, such as funeral directors, grave diggers and stone masons.

The application of modern business streamlining of processes has made Plotbox a cost effective and manpower efficient 'must have' system for the industry worldwide. Putting all this information into one system is already benefiting a wider audience than just those in the death care industry. A by-product has been a growing demand from genealogy researchers and a separate spin-out business is now underway.

Plotbox are graduates of NISP CONNECT's Springboard programme and were the overall winners at the INVENT Awards 2014.

Leona McAllister is delighted at the progress of the company. In just four short years it has achieved more than £500k investment and has confirmed that they are now seeking a further funding round imminently to enhance their team of nine with additional technical support and the development of a an international distributor network.

APPENDIX A: KNOWLEDGE ECONOMY SECTORAL DEFINITIONS

Sector	SIC 2007 Definition	
Medical Devices	26511 MF of electronic instruments & appliances for measuring, navigation, except industrial	32500 MF of medical and dental instruments and supplies
	26513 MF of non-elect' instruments & appliances for measuring, testing and navigation, except industrial	72190 Other research and experimental development on natural sciences and engineering
	26600 MF of irradiation, electromedical and electrotherapeutic equipment	74202 Other specialist photography
	26701 MF of optical precision instruments	
Pharma / Biotechnology	21100 MF of basic pharmaceutical products	72110 Research and experimental development on biotechnology
	21200 MF 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 MF of telegraph and telephone apparatus and equipment	61900 Other telecommunications activities
	26309 Manu of communications equipment	
Computing and Advanced Electronics	26200 MF of computers and peripheral equipment	27200 MF of batteries and accumulators
	26110 MF of electronic components and boards	27310 MF of fibre optic cables
	26400 MF of consumer electronics	27900 MF of other electrical equipment
	26512 MF of electronic industrial process control equipment	28910 Manufacture of machinery for metallurgy
	27110 MF of electric motors, generators, transformers and electricity distribution and control apparatus	
Other Technical Consultancy Services	71121 Engineering design activities for industrial process and 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 MF of engines and turbines, except aircraft, vehicle and cycle engines	29310 MF of electrical and electronic equipment for motor vehicles
	28120 MF of fluid power equipment	29320 MF of other parts and accessories for motor vehicles
	28131 MF of pumps	30110 Building of ships and floating structures
	28132 MF compressors	30120 Building of pleasure and sporting boats
	28150 MF of bearings, gears, gearing and driving elements	30200 MF of railway locos
	29100 MF of motor vehicles	30300 MF of air and spacecraft and related machinery
	29201 MF of bodies	30400 MF of military fighting vehicles
	29202 MF 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	
High Tech Financial Services	64301 Activities of investment trusts	64306 Activities of real estate investment trusts
	64302 Activities of unit trusts	64921 Credit granting by non-deposit taking finance houses and other specialist consumer credit grantors
	64303 Activities of venture and development capital companies	64992 Factoring
	64304 Activities of open-ended investment companies	64999 Financial intermediation not elsewhere classified
	64305 Activities of property unit trusts	65300 Pension funding

APPENDIX B: ACRONYMS USED WITHIN THE REPORT

Acronyms	Term	Acronyms	Term
ABI	Annual Business Inquiry	IVCA	Irish Venture Capital Association
AI	Automated Intelligence	KE	Knowledge Economy
AIM	Alternative Investment Market	KEI	Knowledge Economy Index
apps	Applications	KTP	Knowledge Transfer Partnerships
ASHE	Annual Survey of Hours and Earnings	LFS	Labour Force Survey
BEE	Broad Economy Exports	M&A	Mergers and Acquisitions
Bn	Billion	MF	Mutual Fund
BOI	Bank of Ireland	MRP	Market Resource Partners
BRES	Business Register and Employment Survey	NI	Northern Ireland
BVCA	British Private Equity and Venture Capital Association	NIABI	Northern Ireland Business Inquiry
CEO	Chief Executive Officer	NISP	Northern Ireland Science Park
CHIC	Connected Health Innovation Centre	NISRA	Northern Ireland Statistics and Research Agency
CoE	Census of Employment	NOMIS	National Online Manpower Information System
CTO	Chief Technology Officer	NVQ	National Vocational Qualifications
DEA	District Electoral Area	OECD	Organization for Economic Cooperation and Development
DETI	Department of Enterprise, Trade and Investment	ONS	Office for National Statistics
ECIT	Institute of Electronics, Communications and Information Technology	PCLe	Peripheral Component Interconnect Express
ECM	Equity Capital Markets	Per mil pop	Per million population
FD	First Derivatives	PhD	Doctor of Philosophy
FDI	Foreign Direct Investment	PLC	Public Limited Company
GB	Great Britain	PPSL	Precision Processing Services Ltd
Grads	Graduates	PVB	Polyvinyl butyral
GVA	Gross Added Value	R&D	Research and Development
HEI	Higher Education Institutions	SFA	Selective Financial Assistance
HEIDI	Higher Education Information Database for Institutions	SIC	Standard Industrial Classification
HM	Her Majesty	SME	Small and Medium-sized Enterprises
HoT	Heads of Terms	STEM	Science, Technology, Engineering and Mathematics
IDBR	Inter Departmental Business Register	UK	United Kingdom
INI	Invest Northern Ireland	UKIPO	United Kingdom Intellectual Patent Office
Inv'	investment	US	United States
IoT	Internet of Things	UUEPC	Ulster University Economic Policy Centre
IP	Intellectual Property	VC	Venture Capital



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.

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