

Assessing the Demand for Big Data and Analytics Skills, 2013-2020

April 2014

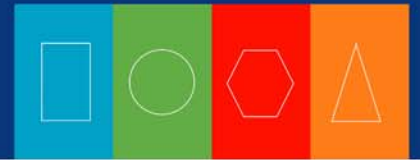
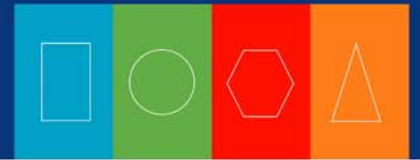


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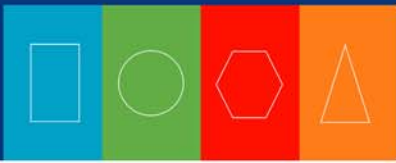


Acknowledgements

Forfás would like to record its appreciation to the members of the Steering Group who oversaw the progress and the development of the report for their significant commitment and contribution - the membership is set out in Appendix 1.

Forfás would like to thank the many industry executives, academics and staff at expert organisations and State Agencies who gave their valuable time and insights through interviews and at workshops.

Forfás would like to acknowledge the high quality and expertise of EY and Oxford Economics whose work included the international trend analysis, the undertaking of the consultations with companies and key informants and the modelling of the big data and analytics skills demand scenarios for Ireland contained in the report.

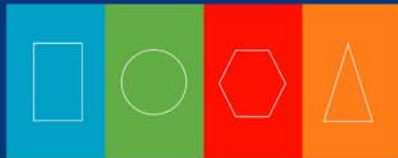


Introduction to the Expert Group on Future Skills Needs

The Expert Group on Future Skills Needs (EGFSN) advises the Irish Government on current and future skills needs of the economy and on other labour market issues that impact on Ireland's enterprise and employment growth. It has a central role in ensuring that labour market needs for skilled workers are anticipated and met.

Established in 1997, the EGFSN reports to the Minister for Education and Skills and the Minister for Jobs, Enterprise and Innovation.

Forfás, Ireland's policy advisory board for enterprise, trade, science, technology and innovation in conjunction with the Skills and Labour Market Unit in SOLAS, provides the EGFSN with research, analysis and secretariat support.



Foreword

This study undertaken by Forfás and the Expert Group on Future Skills Needs is a key input to the Government's *Action Plan for Jobs 2013*. Its aim is to research and identify measures to build up the big data and analytics talent pool over the period up to 2020 in line with enterprise demand. Measures required include improving domestic graduate output; continuing professional development; and where necessary attracting experienced talent from abroad-including expatriate talent.



Big data and analytics is a relatively new area of business activity characterised by rapid growth. Globally, there is a reported shortage of data analytics talent particularly individuals with the required 'deep analytical' skills. At present, no one country or region stands out in the provision of data analytics services. For Ireland to become a leading country in data analytics services it is essential that our skills capability base is sufficient to drive performance within existing enterprises, start-ups and new foreign direct investment.

To understand how data analytics skills demand may evolve, a number of scenarios were developed to depict potential future outturns. Government's policy into the medium-term is for Ireland to become a leading country in Europe for big data and analytics. This would require achieving the scale of the ambition as set out in the high growth Scenario in this study. Under this Scenario, 21,000 potential job vacancies could arise from expansion and replacement demand in the period up to 2020 - comprising 3,630 for deep analytical roles and 17,470 for big data savvy roles. There would also be a further 8,780 potential job openings for supporting technology staff - already included within the demand forecast numbers for ICT professionals in the Forfás/EGFSN report on *Addressing Future Demand for High-Level ICT Skills*.

The achievement of this outcome requires an improved understanding among private and public sector senior executives, of the potential of data analytics for driving business performance - including its greater adoption in the SME sector. An enterprise-wide approach to managing data analytics capabilities is essential including defining skills needs; up-skilling of talent; providing clear career path progression and deploying analytical talent effectively to support business goals.

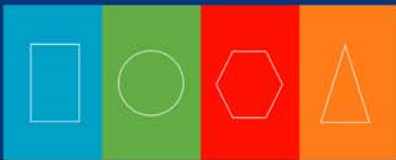
It is also essential for career guidance professionals and enterprises to communicate and raise awareness of the range of interesting career opportunities arising within data analytic businesses to students, particularly females, and to their teachers and parents.

I would like to thank all those who contributed to the successful completion of the report.

Particular thanks are due to the many enterprises and stakeholders who gave their valuable time and expertise to the study. I wish to express my thanks to Margaret Cox who chaired the Steering Group as well as to all members of the Steering Group for their full commitment and support. I would like to record my appreciation to the IDA Ireland and Enterprise Ireland for their support and sharing of expertise. Finally I would like to thank the team at Forfás for leading this project to a successful conclusion.

Una Halligan

Chairperson, Expert Group on Future Skills Needs



Executive Summary

E.1 Purpose and methodology

This study, *Assessing the Demand for Big Data and Analytics Skills in Ireland, 2013 - 2020*, undertaken by Forfás and the Expert Group on Future Skills Needs (EGFSN) is a key input to the Government's *Action Plan for Jobs 2013*. The work includes assessing the demand (both expansion and replacement) for big data and analytics roles and their related skills, competences and qualification requirements and mapping out relevant current and planned education and training output. It proposes actions to address gaps identified between supply and demand and assist in harnessing the considerable economic and social potential of this area into the medium-term. The study sets out patterns of demand in relation to three distinct categories of skills and competencies as follows:

- *Deep analytical talent* - requiring a combination of advanced statistical, analytical and machine learning skills. The shortage of deep analytical talent internationally has been identified as the most acute talent constraint on potential big data and analytics growth;
- *Big data and analytics savvy roles* - individuals at all levels of a business or organisation with an understanding of the value and potential for the exploitation of big data and data analytics. These role-holders frame, interpret and utilise insights from data and take appropriate decisions to advance business performance; and
- *Supporting technology roles* - personnel with the skills to develop, implement and maintain the hardware and software required to make use of big data and data analytics.

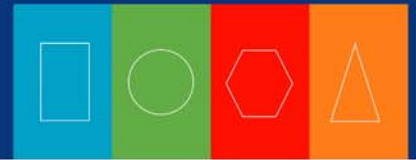
The study's objective is to advance recommendations on measures to build up the big data and analytics talent pool through domestic graduate output, continuing professional development within industry, and, where necessary, attraction of talent from abroad including expatriate talent. The Terms of Reference for the study are set out in Appendix 2.

The research and analysis work for the study was managed by the Forfás Secretariat to the Expert Group on Future Skills Needs and its progress was overseen by a Steering Group made up of representatives from industry, education and relevant Government Departments and Agencies including the Department of Education and Skills, Higher Education Authority, IDA Ireland and Enterprise Ireland.

E.2 Background

The Government has set an ambition for Ireland to become a leading country in Europe in 'Big Data'. It is envisaged that this will help create significant additional employment in the economy. To do this a series of actions are recommended in the *Action Plan for Jobs, 2013* to create an ecosystem based on public and private collaboration which will:

- Directly and indirectly create high-value jobs;
- Strengthen the existing FDI proposition and attract new FDI from top global organisations;
- Foster indigenous enterprise and innovation;
- Attract and develop top talent in a high-value sector; and
- Create value through public and private sector productivity increases.



The above actions are being driven by a joint industry-Government *Big Data Taskforce*.

Many of the elements of an ecosystem to support data analytics and big data are already in place in Ireland. The most important element is the existing base of active enterprises in this space. This enterprise base includes:

- Multinational enterprises that are providers of services and solutions for analytics and big data;
- Multinational enterprises whose businesses are built in whole or in part on the application of analytics and big data technologies; and
- A growing base of indigenous companies whose business focuses on IT solutions for analytics and/or for whom analytics is central to their business offering.

This ecosystem also includes a growing base of relevant publically funded research activity (including the Insight Centre for Data Analytics (INSIGHT) and the Centre for Applied Data Analytics Research - CeADAR). Ireland has prioritised the area of 'Data analytics, Management, Security and Privacy' as part of its research prioritisation¹ and there are a considerable number of researchers already active in the fields of big data and analytics.

Globally, there is a reported shortage of personnel with the required 'deep analytical' skills and also individuals who have a combination of technological and business skills to both generate business intelligence and to take action based on the insights generated ('data savvy' employees).

All of the above highlights the requirement for Ireland to build up a sufficient analytics talent pool in order to take advantage of the potential business and employment opportunities in this area. The value of big data and analytics is becoming apparent across countries and is resulting in a growing demand for relevant skills. At present, no one country or region stands out in the provision of related services. For Ireland to aspire to such a status, it is essential that the necessary skills capability base is developed to drive the performance of data analytics businesses and capitalise on potential growth and employment opportunities.

E.3 Defining Big Data and Data Analytics

While big data and data analytics have gained prominence in recent years, there is no single, internationally recognised definition of 'big data' and no operational definition that can be used to determine market or skills development.²

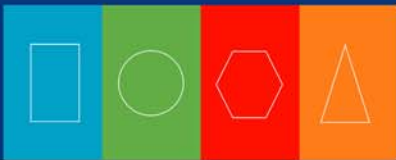
Although there is no uniform definition of big data activities, a degree of consensus is evident in the widespread use of the '3Vs' which define big data in terms of the 'volume, variety and velocity' of data³:

- Volume - referring to data stores of petabytes or above;
- Variety - referring to diverse formats of data generation sourced from various mechanisms; and
- Velocity - referring to the requirement for real time collections/analysis of data.

¹ Report of the Research Prioritisation Steering Group, Forfás, March 2012.

² e-Skills UK, (2013) Big Data Analytics - an assessment of demand for labour and skills, 2012-2017.

³ See Hagstrom, M., Manocha, I. (2013), The Big Opportunity for Inclusive Growth in World Economic Forum (2013) Global Technology Report 2013; Intel (2012), Big data analytics, Intel's IT manager survey on how organisations are using big data; E-skills UK, (2013), Big Data Analytics- an assessment of demand for labour and skills, 2012-2017; IDR (2012), The digital universe in 2020: big data, bigger digital shadows, and biggest growth in the Far East.



The term 'Big Data' has been devised to describe the exponential increase, obtainability and use of information in both structured and unstructured forms. The upsurge in big data has been driven by escalating volumes of detailed information originating from organisations, mass media and multimedia, social networking platforms and the 'Internet of Things'. Data analytics, the analysis of large data sets, has become a fundamental element for both private sector and public sector organisations who wish to compete through ever-evolving technology, productivity advancement, and innovation in research and development. It is also important to note the value of what can be termed 'small data'. For some firms - in particular small businesses in more traditional sectors - the types of business data becoming available will be of smaller volume, slower velocity and narrower variety. Nonetheless, enhanced use of this data in a smart way, and application of analytical techniques can realise business value.

For the purposes of this project, data analytics is understood as the mining, analysis, interpretation and purposeful utilisation of Data, including Big Data. This process of extracting and analysing data to generate economic value has been noted as a key future requirement for enterprises and organisations across all sectors.

E4. Big Data and Analytics: Drivers of Change

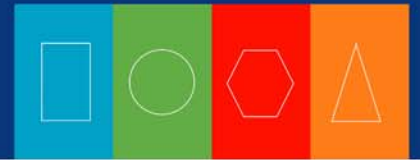
With an explosion in the level of data being created, there is an increased recognition among enterprises of the potential business value that can be extracted. Advantages include:

- Finding and accelerating growth opportunities – drawing on internal and external data to help model and predict business outcomes, identify the most profitable opportunities and differentiate businesses from their rivals;
- Improving business performance – enabling agile planning, more accurate forecasting, better budgeting and trusted decision-making support;
- Managing risk and regulatory pressures – improving reporting processes through the exploitation of more robust data, while also identifying potential risk areas, such as compliance violations, fraud or reputational damage⁴; and
- Exploiting emerging technologies – continually identifying new opportunities to gain insights from data.

Notwithstanding these drivers, there has not been uniformity in the rate of adoption of big data and analytics across companies and industries. Some sectors and larger firms are further along the 'maturity curve' than others. At the same time, a number of issues are emerging globally which may act to constrain big data and analytics growth. These include some scepticism of the actual value generated, concerns over a 'big data hype'; the need to be able to identify and process the 'right' data among the vast quantities of information produced; and, most pressingly, skills shortages.

In Ireland, the level of adoption of analytics in the delivery of public services has been slower than leading countries (with a number of exceptions). In the medium-term, important Government initiatives include several supporting actions and investments as set out in the *Action Plan for Jobs 2013*. These are being built on further in the *Action Plan for Jobs 2014*, including the launch of an Open Data initiative which will include the establishment of an Open Data portal to act as the primary source of public sector datasets in the context of Ireland's membership of the Open

⁴ Big risks require big data thinking , Global Forensic Data Analytics Survey 2014 (EY 2014)



Government Partnership. Also, the further strengthening of the mechanisms for data sharing and the use of data across government by enacting the required legislation, setting up a platform to facilitate data analytics within Government and taking steps to further strengthen Ireland's national data infrastructure.

In business top level management support is required for placing analytics at the centre of the decision-making process as an integral part of its culture. In the absence of such commitment, there is a risk of analytics being viewed as a silo activity. Given the early stage of development of data analytics activity both in Ireland and internationally, a particular focus should be on improving senior executives' understanding of the potential value of data analytics activities for enhancing business performance. This includes decisions on the talent and technology required and what structured data metrics to collect. This will help avoid the sense that 'we are drowning in data - but starving of knowledge'. Success stories are crucial to encourage others to follow in the take-up of analytics. This requires increased advocacy and publicity. The key to maximising the value of analytics is for firms and organisations to take an enterprise-wide approach to managing their analytical talent, including defining needs; sourcing and nurturing talent; providing interesting and challenging work and deploying analytical talent effectively in line with strategic business needs.

At present, the adoption of big data and analytics in Ireland is greatest in sectors such as ICT, financial and insurance activities, manufacturing, telecoms, utilities, retail /wholesale and to a lesser degree in healthcare, pharmaceuticals, transport and government. Companies are starting to interact directly with consumers due to increased usage of mobile devices: many sectors are beginning to behave like retail in their use of data to drive new business. The broad theme emerging in this study is that in the future, big data and analytics activities will be relevant across all industries where data are created in significant volumes.

E.5 Baseline employment demand in Big Data and Analytics

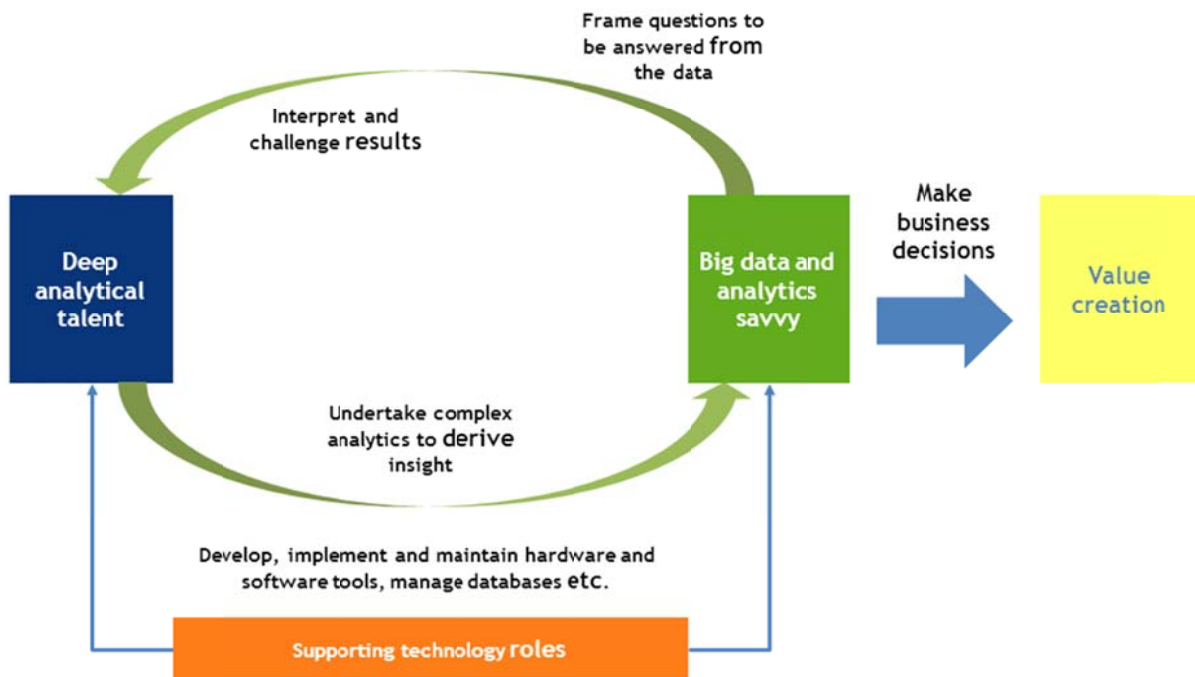
Big data and analytics is a relatively new area of business activity characterised by rapid growth. Notwithstanding the myriad opportunities for innovation, productivity and value creation, the recent emergence of this area presents some difficulties for policy makers in understanding existing employment, definitions of roles and related issues. In the absence of an official measure of employment demand in this area, this study considered findings from a range of sources in order to arrive at an estimate of baseline employment demand:

- Research and analysis for other countries derived from a review of international literature;
- Analysis undertaken to apply estimates in an Irish context;
- Insights from the qualitative research undertaken for the project; and
- Analysis of available data for Ireland to assist in understanding the likely sectoral distribution of employment across industries.

This study considers employment demand across three main skills categories, namely deep analytical roles, big data and analytics "savvy" roles and supporting technology roles. Figure E.1 illustrates how these roles interact to contribute towards creating business value.



Figure E.1 Interrelationship between Data Analytics Skills and Competency Groups



Within the deep analytical talent category a distinction is made between two groups: jobs in more established occupations requiring considerable analytical ability, and emerging jobs in analytics more typically involved in deriving insight from big data. While the “established” analytical roles call for advanced quantitative ability, the employment demand for these jobs is less likely to be influenced by the proliferation of data to the extent that “emerging” roles like that of ‘data scientist’ may be. For this reason, applying the type of growth rates envisaged on account of increased data intensiveness to the entire cohort may result in an overstatement of skills demand. Those in data savvy managers and analysts, roles require conceptual knowledge and quantitative skills in order to frame the questions to be answered from the data and to interpret and challenge the analysis undertaken. This is with a view to making better business decisions that will create value for the company. People in these roles require detailed domain and sectoral knowledge and an intuitive feel for what the data is telling them. This will be particularly true as real time data availability grows and as more business decisions are taken rapidly and in response to patterns emerging from the data. Their communication skills are important as they will routinely be required to have two different conversations on the same topic - one with those in deep analytic roles and the other with the board / senior management.

Those in supporting technology roles develop, implement and maintain the hardware and software tools and manage the databases to economically extract value from a wide variety of data. This includes the use of Hadoop, an open source processing framework.

Based on a combination of ‘top-down’ approaches (applying international estimates to Ireland, with some adjustments), insight gained from the consultation phase with companies and stakeholders, and available data on the Irish labour market, the estimated baseline employment demand in 2013 is set out in Table E.1



Table E.1 Estimate of Baseline Employment Demand for Big Data and Analytics Skills in Ireland, 2013

Category	Employment Demand ⁵	% Total Employment
Deep analytical talent	3,300	0.18
<i>Of which</i>		
<i>emerging analytics roles</i>	1,500	0.08
<i>established analytical roles</i>	1,800	0.10
Big data savvy	25,780	1.38
Supporting technology professionals	6,000	0.32
Total	35,080	1.88

Source: EY, Oxford Economics

In terms of sectoral distribution of employment, replication of international analysis and an analysis of the data intensity of industry here in Ireland, points to a concentration of employment in financial and insurance services, information and communications technology and industry.

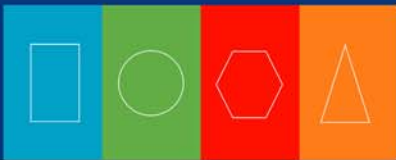
E6. Findings from the Consultations

Capturing the views of employers in the big data and analytics sphere is critical to understanding current industry trends and anticipated future developments. To this end, a broad-based consultation phase involving 55 companies, organisations and stakeholders was completed through a process of structured research work including:

- Interviews with 35 enterprises consisting of both Irish operations of major multi-national corporations and indigenous Irish firms. Enterprises consulted included both companies operating across sectors using big data and analytics, and service providers operating in the analytics domain.
- Structured interview surveys with 7 government bodies including statutory offices, government departments and state agencies.
- Structured interview surveys with 3 domestic research centres which specialise in big data and analytics.
- The views of a range of 10 key informants - both domestic policy influencers and international industry leaders.
- A series of three sector focused workshops which heard the views of a wide range of stakeholders in this area, from academia and industry (including specialist service providers, firms in finance and insurance, transport and logistics sectors, wholesale and retail, and manufacturing).

This process allowed the incorporation of views from industry, academia and other interested parties. The process also benefitted from inputs by members of the Government 'Big Data' Taskforce at presentations made to the group.

⁵ These figures represent existing demand across each category. Within this, a level of unmet demand can be expected. According to the results of the firm-level interviews there are difficult-to-fill data analytics vacancies as things stand. The survey interviews showed that these firms had vacancies corresponding to 17% of existing employment in deep analytical talent; 3% in big data savvy roles and 2% in supporting technology roles.



E7. Employer Consultations

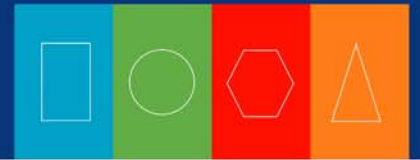
Despite the variety of firms interviewed across sectors and of different sizes, industry and service providers, consensus emerged on a number of important themes:

- *Gender:* Across the three categories of skills, employment is male-dominated.
- *Hard to fill vacancies:* There are current vacancies across categories with deep analytical talent roles being hardest to fill.
- *Barriers to filling vacancies:* Employers view an insufficient level of experience as the key barrier to filling deep analytical talent vacancies. This may be due to the early stage of data analytics business activity. Experience is also a challenge when it comes to big data savvy roles, along with insufficient skillsets. For the supporting technology group, experience levels again feature, along with insufficient technical skills of applicants.
- *Future demand:* Private sector employers are positive about the future and, on average, anticipate a doubling of big data and analytics employment levels over the period to 2020. Public sector employers are less ambitious about their future employment levels, in part due to the current restrictions on recruitment. Part of their demand is likely to be addressed through outsourcing to the private sector.
- *Skills supply:* Employers are less optimistic regarding skills supply, with the majority foreseeing difficulties over the period.
- *In-house training:* Encouragingly, most firms provide in-house training and the majority also have relationships with higher education institutes to aid in sourcing talent.

E8. Key Informant Consultations

These ten interviews included some parent companies of multinational firms based in Ireland and domestic policy informants from Government Departments and State Agencies. A number of common themes were evident:

- International and domestic informants were optimistic as to how Ireland can position itself to become a world leader in this area. The strengths Ireland has demonstrated in growing other sectors can again be harnessed to capitalise on opportunities in big data and analytics.
- There is an active and growing research agenda in Ireland aided by the Government's research prioritisation focus on the area of *Data Analytics, Management, Security and Privacy*, and significant funding from Science Foundation Ireland.
- To position Ireland to become a leading country for data analytics a range of steps will be required so that as much of the potential pipeline of analytics talent will choose careers in this area. This can be done by developing attractive career paths and inspiring the next generation of analytics talent. In addition, more places in 3rd level analytics related courses are required.
- It was cited that industry must drive the up-skilling of existing employees in the competencies required.
- The adoption of analytics is at a slower pace of development in Ireland and a cultural change will be needed to realise the full benefits on offer.
- Informants were of the view that this can be aided by availability of more data on an open-source basis.



E9. Future demand for Big Data and Data Analytics

Developing Scenarios

In order to understand how demand may evolve over the period to 2020, a number of scenarios were developed. These scenarios are designed to depict potential future outturns, rather than represent definitive forecasts. In building out the potential medium-term scenarios, the analysis draws on a range of research and data sources including:

- Analysis of big data and analytics business global growth projections from a review of international literature;
- Qualitative insight derived from the company consultation phase, the key informant interviews and the three workshops; and
- Analysis of domestic economy sectoral employment forecasts from the EY and Oxford Economics Winter 2013 *Economic Eye*.⁶

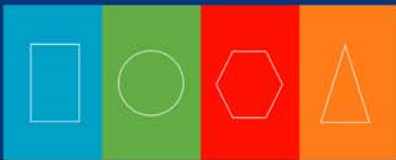
Three scenarios are set out as follows:

- Scenario 1 - a low growth scenario whereby employment in big data and analytics roles only grows in line with the forecast total employment growth rate within key data intensive sectors.
- Scenario 2 - a moderate growth scenario whereby Ireland achieves a similar proportion of big data and analytics roles within total economy employment as forecast for other countries (in particular the UK).
- Scenario 3 - a high growth scenario whereby Ireland achieves the vision set out in the *Action Plan for Jobs 2013* of becoming 'a leading country in Europe for big data'. This is predicated on the growth of big data and analytics employment within existing firms, new firms becoming involved and a level of foreign direct investment in big data and analytics.

The low growth Scenario 1 assumes no further policy action or specific measures aimed at increasing the level of adoption of big data and analytics across the economy. In practice, the Government has announced a range of steps to drive this area and so the prospect of the outturn in Scenario 1 materialising is low. Given the weight of policy focus afforded in this area, investment in major research infrastructure and recent announcements in relation to Open Government, it is considered far more likely that Ireland will converge with international comparators with regard to the level of adoption of big data and analytics, as in the moderate growth Scenario 2.

The medium-term policy objective, as stated in the *Action Plan for Jobs 2013*, is to drive Ireland beyond convergence and strive to become a leading country in Europe for big data and analytics and this would achieve the scale of the ambition set out in Scenario 3. Given Ireland's scale, policy agility and reputation in related fields like ICT, there is a clear and realistic opportunity for Ireland to achieve convergence and over-take leading economies in Europe in this space.

⁶ The Government's published Medium-Term Economic Strategy (2013) forecasts a slightly higher total employment level for 2020, with aggregate employment 4% higher than under the Economic Eye model. The Economic Eye model is used because it includes a sectoral breakdown which is necessary for undertaking the demand forecast exercise.



The assumptions and outcomes of each scenario are summarised in the Table E.2. The outcomes for each scenario depend on the drivers and supporting conditions being present.

Table E.2 Summary of Scenario Assumptions, Drivers and Supporting Conditions

		Scenario 1	Scenario 2	Scenario 3
Drivers	Wider economy baseline sector projections	■	■	■
	Increase in existing firm data intensity to forecast UK and US levels		■	
	Marked increase in data intensity across the whole economy, including within the public sector and a broad range of private firms			■
	Expansion of existing firms' big data activities		■	■
	New, additional greenfield mobile big data FDI attracted to Ireland			■
	Full implementation of measures relating to Open Government		■	■
	Full implementation of measures set out in the <i>Action Plan for Jobs</i>			■
Supporting conditions	No special effort, public or private, to influence the demand-side or supply-side	■		
	Modest boost in domestic big data talent supply and modest improvement in environment for attracting external big data talent (e.g. employment permit eligibility)		■	
	Major boost in domestic big data talent supply and improvement in environment for attracting external big data talent			■
	Removal of barriers to domestic big data growth such as greater access to open data		■	■
	Widespread adoption of data analytics in the public sector			■
	Significant improvement in Ireland's big data international competitiveness offering, especially versus European competitors			■
Outcomes	No change in economy-wide data intensity from today's level	■		
	Decline in Ireland's global big data market share	■		
	Ireland's global big data market share converges with other countries		■	
	Exploitation of domestic big data opportunities amongst existing organisations, public and private			■
	Rise in Ireland's global big data and analytics market share			■
	Ireland becomes a leading country in Europe for big data and analytics			■

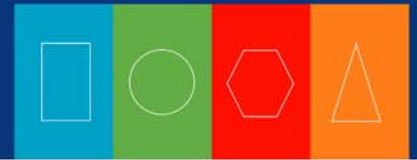


Table E.3 presents estimates of the 2013 baseline demand for the three main categories of data analytic roles, then for each scenario, the expansion and upskilling demand change anticipated over the period up to 2020; and the resultant demand level in year 2020. Expansion demand comprises the main demand component for deep analytical roles and supporting technology roles. For Big data savvy roles there is an equal balance between the expansion and upskilling demand components. Details on how these figures were arrived at are presented in Chapter 5.

Table E.3 Baseline, Expansion and Up-skilling Demand Change 2013-2020

	Baseline 2013	Expansion & Up-skilling demand change 2013-2020	Demand 2020
Scenario 1			
Deep analytical talent	3,300	435	3,735
<i>of which emerging analytics roles</i>	<i>1,500</i>	<i>210</i>	<i>1,710</i>
<i>of which established analytical roles</i>	<i>1,800</i>	<i>224</i>	<i>2,024</i>
Big data and analytics savvy	25,780	4,095	29,875
Supporting technology professionals	6,000	840	6,840
Total	35,080	5,370	40,450
Scenario 2			
Deep analytical talent	3,300	1,127	4,427
<i>of which emerging analytics roles</i>	<i>1,500</i>	<i>903</i>	<i>2,403</i>
<i>of which established analytical roles</i>	<i>1,800</i>	<i>224</i>	<i>2,024</i>
Big data and analytics savvy	25,780	9,635	35,415
Supporting technology professionals	6,000	3,610	9,610
Total	35,080	14,372	49,452
Scenario 3			
Deep analytical talent	3,300	2,558	5,858
<i>of which emerging analytics roles</i>	<i>1,500</i>	<i>2,333</i>	<i>3,833</i>
<i>of which established analytical roles</i>	<i>1,800</i>	<i>224</i>	<i>2,024</i>
Big data and analytics savvy	25,780	16,915	42,695
Supporting technology professionals	6,000	7,667	13,667
Total	35,080	27,140	62,220

Source: EY, Oxford Economics

E10. Potential Job Openings for Big Data and Data Analytics roles

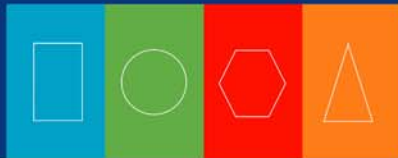
In estimating total job openings for Big Data and data analytics roles that will need to be filled by new supply up to 2020, account needs to be taken of the expansion and replacement demand⁷ growth components (upskilling demand relates to those already in employment). Table E.4 presents the demand growth components for each scenario. In the medium-term and consistent with the Government's *Action Plan for Jobs 2013*, policy aim is to drive Ireland beyond convergence and strive to become a leading country in Europe for data analytics, achieving the scale of the ambition as set out in the high growth Scenario 3. In terms of potential job openings under Scenario 3 up to 2020, there could be an estimated 29,880 job openings, comprising 3,630 for deep analytical roles; 17,470 for big data savvy roles, with a further 8,780 potential job openings for supporting technology staff (this number is part of the job openings demand forecast for ICT professionals contained in the Forfás/EGFSN report on Addressing Future Demand for High-Level ICT Skills, 2013).

Table E.4 Summary of Future Demand Change Projections 2013 -2020

	Scenario 1 (low growth)	Scenario 2 (delayed catch-up)	Scenario 3 (a leading country in Europe)
Expansion demand			
Deep analytical talent	410	1,050	2,380
<i>of which emerging analytics roles</i>	<i>190</i>	<i>830</i>	<i>2,160</i>
<i>of which established analytical roles</i>	<i>220</i>	<i>220</i>	<i>220</i>
Big data savvy roles	2,040	4,810	8,450
Supporting technology roles	780	3,340	7,100
Total Expansion demand	3,230	9,200	17,930
Replacement demand			
Deep analytical talent	1,250	1,250	1,250
<i>of which emerging analytics roles</i>	<i>370</i>	<i>370</i>	<i>370</i>
<i>of which established analytical roles</i>	<i>880</i>	<i>880</i>	<i>880</i>
Big data savvy roles	9,020	9,020	9,020
Supporting technology roles	1,680	1,680	1,680
Total Replacement demand	11,950	11,950	11,950
Potential Job Openings			
Deep analytical talent	1,660	2,300	3,630
<i>of which emerging analytics roles</i>	<i>560</i>	<i>1,200</i>	<i>2,530</i>
<i>of which established analytical roles</i>	<i>1,100</i>	<i>1,100</i>	<i>1,100</i>
Big data savvy roles	11,060	13,830	17,470
Supporting technology roles	2,460	5,020	8,780
Total Potential Job Openings	15,180	21,150	29,880
Up-skilling Demand			
Deep analytical roles	20	70	170
Big data Savvy roles	2,050	4,820	8,460
Supporting Technology roles	60	270	570
Total Up-Skilling demand	2,130	5,160	9,200

Source: EY, Oxford Economics

⁷ Replacement demand consists of existing jobs that have to be filled due to retirements, job switching to non- analytics roles, move to inactivity, emigration or other reasons. It does not include vacancies arising through analytics professionals moving between companies in the domestic economy, which constitutes job churn.



E11. Skills, Competences and Qualifications

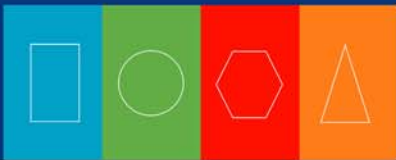
A key objective of this study is to forecast the likely future demand for big data and analytics skills, competences and qualification requirements. Table E.5 presents an outline of the types of technical and business skills, competences and qualifications in demand across three main skills categories as identified through the consultation and research process. Interdisciplinary skills are becoming increasingly important.

There are also related skill requirements arising in professional areas including finance, legal, internal audit and risk control. At a more general level, an appreciation for, and competency to use data is becoming an increasing requirement of individual's work.

Table E.5 Illustration of Types of Skills, Competences and Qualifications Required Across Categories

	Deep Analytical Talent	Big Data and Analytics Savvy	Supporting Technology
Technical and analytical	<ul style="list-style-type: none"> Advanced mathematical, statistical and analytical ability NoSQL Data visualisation Web analytics R and other statistical analysis packages Data mining Social media analytics Ability to deal with structured and semi/unstructured information 	<ul style="list-style-type: none"> Conceptual knowledge, quantitative and analytical skills Data protection, governance, and IP knowledge Enterprise Data management Specific user tools, (i.e. dashboards/KPI data/market analysis) 	<ul style="list-style-type: none"> Various programming languages, data related applications and processes Hadoop, Java, C++, Oracle Building, implementing and managing Hadoop environments Mapreduce Database management and administration - SQL, MySQL, NoSQL
Business and soft skills	<ul style="list-style-type: none"> Communications skills Business acumen Problem solving, creativity, ethics and teamworking skills Domain and sectoral knowledge 	<ul style="list-style-type: none"> Detailed domain and sectoral knowledge Knowledge of social media Business Strategy Project Management Business intelligence Ethics 	<ul style="list-style-type: none"> Communications, problem solving, ethics and teamworking skills Domain and sectoral knowledge Social media technologies Design / user experience skills

Source: EY, 2014



A firm consensus is yet to emerge among companies as to the precise level of qualifications required to fill deep analytical talent vacancies. Some firms reported that a specialist degree in analytics or management science would be an ideal qualification; other companies reported a preference for Masters' and PhD graduates in quantitative and problem-solving areas such as engineering and maths. In either case, a considerable level of training and education specialism is required. As analytics activities develop, it is likely that more refined skill categories will emerge and with this more precise levels of qualification requirements.

Domain knowledge requirements will vary across sectors. There are also different types of firms, each of which will have differing type of balance of skills. These include:

- Firms which are specialist analytics service providers;
- Service providers in other areas that will increasingly be expected to have an analytics capacity in key functional areas - examples include business process outsourcing, marketing and human resources; and
- Firms in industry using analytics as a management tool for the design and delivery of products and services and improving their internal financial, quality and production performance.

E12. Big Data and Analytics Skills Supply

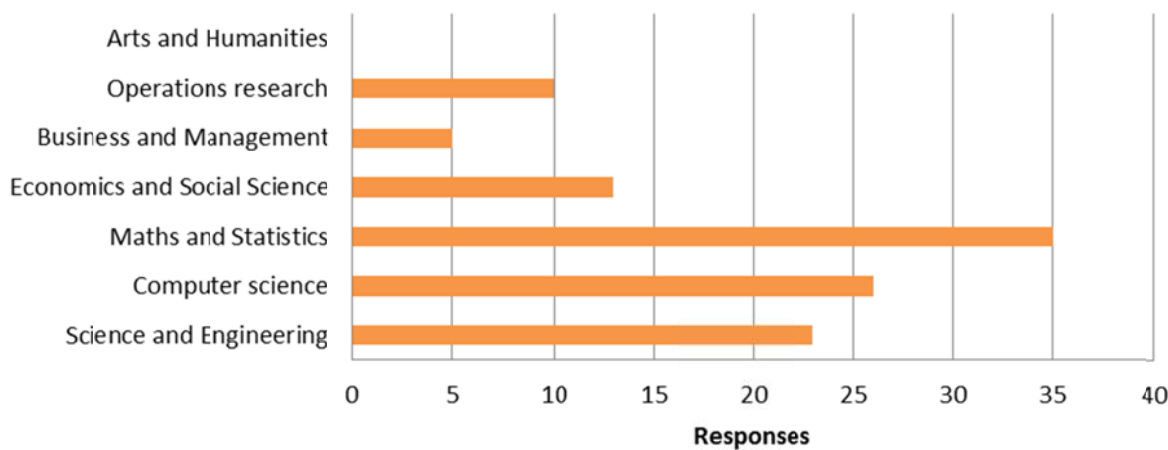
There is agreement in the international literature and among the firms and organisations consulted that the most acute skills shortages relate to the deep analytical talent cohort. A range of academic disciplines (including business analytics, computer science, statistics, engineering, maths and physics) can provide the type of skills required. Respondents to the survey interview concurred with these sources of talent as shown in Figure E.2.

Maths, statistics and computer science disciplines are the most common anticipated sources of skills for deep analytical roles. Business and management disciplines feature prominently as a source of big data savvy roles. The computer science discipline is the most common anticipated source for supporting technology roles.

In addition, the stakeholder workshops and key informant consultations noted that non-typical disciplines like econometrics, chemistry and quantitative and computational social sciences can also offer the types of skills required.



Figure E.2 Deep Analytical Talent - Future Sources of Skills



Given the breadth of relevant disciplines, graduates from these disciplines are also attracted to a range of other careers. Intense competition from other occupations means that only a small proportion of a country's analytics talent end up in analytics jobs. International findings reviewed cited insight from talent management experts indicating that between 10 and 20 per cent of potential analytics talent actually take up analytics jobs. The remainder goes into a range of roles including investment banking and academia.

There is currently a range of specialist and major component analytics courses available in Ireland and complementary disciplines which may also be suitable pipelines for analytics talent. These include 15 dedicated data analytics courses with an enrolment of approximately 500 students. Four additional programmes are planned for a 2014 or 2015 start. These programmes are mainly at Honours Degree/NFQ Level 8 and Master's Degree/NFQ level 9. Most of these programmes have only recently been set up and just four had recorded graduate numbers in 2011.

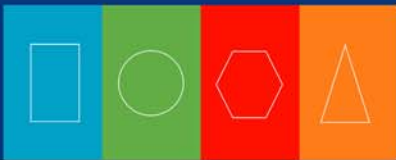
At present there are 18 programmes (with 760 students enrolled) which have significant streams or electives in data analytics. These are on both undergraduate and postgraduate degrees in computing, cloud computing, business information systems and other areas where students have a choice of modules or electives.

In addition, a range of complementary disciplines can provide the necessary skills available. The analysis has reviewed the numbers of enrolments and graduates from these areas as follows:

- There are a range of maths, statistics and combined maths / statistics / computer science courses. In 2013, these courses had 1,600 enrolments and there were 520 graduates in 2011.
- In 2011, there were 400 NFQ level 9 awards conferred in engineering and 152 at NFQ Level 10.
- The corresponding numbers for physics are 22 at NFQ Level 9 and 68 at NFQ Level 10.

Graduates of these programmes are well placed to take up careers in deep analytics roles.

Over the period 2015 to 2019, the data analytic supply will be considerably bolstered by planned output of 126 PhD graduates and 126 MSc graduates from the Insight Centre for Data Analytics which



has a strong focus on industry relevance and readiness.⁸ A target is in place to have industry as the first destination upon graduation for some 50% of graduates.

The analysis of supply of talent undertaken for this study suggest that the approximate annual output of graduates from disciplines potentially capable of taking up roles requiring deep analytical talent is currently in the region of 2,000.⁹ Because the majority of such graduates chose careers paths in occupations other than analytics, it is important to focus both on attracting candidates from this pool into data analytics careers and also on increasing its overall size.

E13. Policy measures in place - Domestic and International

The race for talent and international approaches

Given the skills shortages forecast globally, it is clear that the race for analytics talent is now on. Countries are taking a range of approaches to enhancing the quantity and quality of skills being developed. A key emerging trend observed internationally is the interdisciplinary approach to big data and analytics education. This approach allows universities to re-orientate and / or leverage existing resources and collaborate across many academic departments including computing, business, statistics, marketing and economics.

Accordingly, data analytics programmes are run under the auspices of varying academic departments within third level institutes, including business, engineering, computer science, statistics, and digital media departments. In some countries - for example in the USA - the majority are run through business departments.

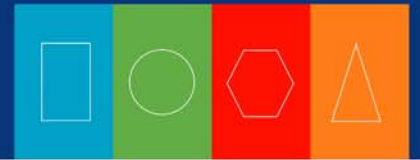
In the UK, the policy response has included establishing a Big Data Academy in a university setting with the support of enterprise. This collaboration is designed to help build up an adequate supply of data analytics talent to meet industry needs. Such collaboration of industry with higher education is the key trend emerging internationally. Approaches to enterprise involvement include:

- Offering 'real world' work problems and large datasets to mine;
- Providing data analytics software and hardware;
- Providing relevant work experience opportunities;
- Shaping specialisms or electives within programmes (including the provision of the taught modules); and
- Promoting analytics as a career path for students.

Domestically, a range of steps have been taken to assist progress in this area. These include the supporting actions set out in the Government's *Action Plan for Jobs 2013* and the establishment of major data analytic research centres (INSIGHT and CeADAR) with investment from Science Foundation Ireland, IDA Ireland and Enterprise Ireland. The roll-out of actions recently announced by the Minister for Public Expenditure and Reform in relation to Open Government and Open Data will be important.

⁸ The Insight Centre for Data Analytics is a joint initiative between researchers at UCC, UCDC, NUI Galway, DCU and other partner institutes including Trinity College Dublin, NUI Maynooth, Royal Irish Academy and the Tyndall National Institute. It was established in 2013 by Science Foundation Ireland funding of €75m.

⁹ The potential deep analytics talent pool is broad. For the purposes of this exercise graduates included are at NFQ Level 8 and above in specialist analytics courses, courses with significant analytics components and maths / statistics and combined maths / computer science. Also included are NFQ Level 9 and 10 in physics and engineering.



E14. Findings and Recommendations

Based on the desk-based research, in-depth consultation with employers, analysis of international literature, detailed discussion with key informants and stakeholders, and valuable input from members of the EGFSN Steering Group, this study has arrived at a set of findings across several themes as discussed below.

Building up the supply of analytics talent

In order to convince existing organisations and new inward investors that Ireland is able to meet future talent demand (while ensuring competitive wage levels and avoiding displacement of talent from existing firms) it is important that the talent supply is not only flexible but perhaps also available in advance of potential future demand. The latter point has implications for the timing of increasing the deep analytical graduate domestic output; bringing forward any necessary changes in the employment permit system; and enterprises role in the up-skilling for big data savvy roles.

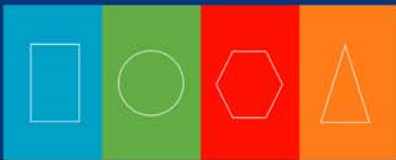
An improved understanding among senior executives of the potential of data and analytics for driving business performance is essential. Successful firms adopt an enterprise-wide approach to managing analytics capabilities in line with their strategic business goals. This includes defining analytical talent requirements; sourcing of new analytical talent; up-skilling analytical workforce skills; providing career progression opportunities and deploying their analytical talent effectively.

The paramount policy challenge is to ensure that the right level of talent is available in the workplace. Firm consensus is yet to emerge among companies as to the precise level of qualifications required to fill deep analytical talent vacancies. Some firms reported that a specialist degree in analytics or management science is an ideal qualification; other companies had a preference for Masters' and PhD graduates in quantitative and problem-solving areas such as engineering and maths.

The clear message however is that firms are experiencing constrained skills supply. Given the breadth of the potential supply pool it is not possible to directly transpose supply onto demand in order to point to a specific quantum of skills gap. That said however, the firm position emanating from the enterprise and key informant consultations is that the risk of over-supply of deep analytical graduate talent is negligible. The combined view of stakeholders and employers is that there is sufficient demand to absorb a significant increase in the level of post graduate output which has had enterprise involvement including relevant work placement. A continued focus on increasing the output of industry-ready PhDs (such as the planned pipeline through INSIGHT) is therefore justified.

Relevant findings from the consultation are as follows:

- While firms surveyed are optimistic and ambitious in relation to employment opportunities, they expressed some concern in relation to talent supply. The most challenging obstacle identified by industry to future employment growth was that prospective employees lacked a sufficient level of work experience.
- A further central theme to emerge from the consultation was that as technologies and applications evolve, the skills taught in third level institutes must remain relevant to the needs of industry. This will include a continuous focus on the mix of technical and business skills, which firms anticipate will evolve over the period.



- There is broad consensus in the literature - affirmed in the consultations - that the deep analytical talent pool will be most constrained and likely to suffer from supply shortages. This should not mean a sole focus on this group however and it is also important that the education system caters for the needs of industry for data users who are big data and analytics savvy.
- The core channel through which the skills pool for big data and analytics savvy individuals will be delivered in the short-term is through up-skilling and retraining. Industry must drive this process.
- For building up the pipeline of talent into the future, the education system should focus on enhancing numeracy and quantitative skills at all levels and as wide a variety of courses and disciplines as possible should involve teaching basic concepts in data management and analysis.

A combination of new domestic graduates, continuing professional development and inward migration - including expatriate talent should be used to enhance the talent pool.

Appealing to the widest possible talent pool

This study has shown that into the future, relevant talent must be proactively attracted into analytics careers to meet the increasing numbers of job openings likely to arise. While talent for big data and analytics roles may be sourced from a range of disciplines, in practice analytics careers are just one potential career path for the cadre of skills emerging.

- For the deep analytical talent cohort it is important that roles appeal to the broadest range of graduates. It is critical that every effort is made to enhance the appeal of big data and analytics occupations in order to maximise the potential flow of talent available.
- Talent available for Big data and analytics savvy roles can be filled from a wide range of sources, including business and humanities graduates.

Inspiring the next generation of analytics talent

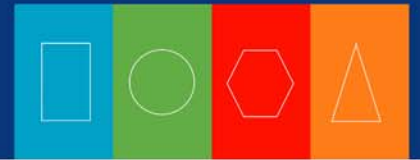
If Ireland is to become a leading country in Europe for big data and analytics, there is a need for a step change in the awareness and image of the business area. While this will be a multi-faceted process, appealing to a new generation of talent will be pivotal, not least in order to boost the long-term pipeline of skills supply.

Measuring progress

This report has set out the challenges inherent in measuring and forecasting big data and analytics employment. In order to monitor progress in this area in the future, robust data needs to be compiled on an ongoing basis.

Unlocking the potential of big data and analytics in the public sector

Alongside the range of skills-focused findings, a main finding of this study is that the level of use and exploitation of the value of data analytics in the public service in Ireland is at an earlier stage of maturity than in leading countries. The State has an unparalleled level of interaction with citizens through the delivery of public services, administration of the tax system and distribution of

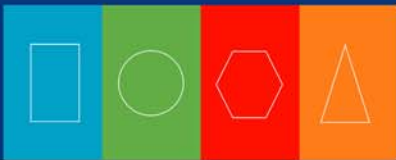


social transfers. There is substantial potential for enhanced efficiency, cost savings and improved outcomes through the deployment of analytics on a more widespread scale.

In the short-term, the introduction of post codes will build on the expanded data infrastructure achieved in recent years as will the planned introduction of personal health identifiers and moves towards company identifiers. While ongoing fiscal constraints and the public service numbers ceiling limit the capacity for investment to a degree, the Irish public administration has proved agile and responsive in the past and with a number of actions, will be able to realise gains in this area. Ireland's full participation in the Open Government Partnership and supporting actions will assist in driving this adoption further. At a corporate level, Ireland is already home to a number of high profile enterprises - both foreign owned and indigenous - who are involved in applying cutting-edge analytical techniques. These companies could be encouraged to assist public bodies in applying similar techniques to public service challenges.

In response to the overall findings of this study, a set of recommendations is advanced across each key area. They are denoted by anticipated time period for implementation: Short-term (1-2 years), Medium-term (3-4 years) and Long-term (5 years +).

Taken together, the actions set out here represent a firm roadmap for building up the analytics talent pool in Ireland and assisting in achieving the medium-term vision of making Ireland a leading country in Europe for big data and analytics.



1. Boost the output and quality of Deep Analytical Talent

- Enterprise and education providers should collaborate to increase the output and ensure the quality and relevance of deep analytics courses. Industry expert participation should be facilitated in course delivery. This would involve teaching modules and making datasets and other resources available which enhance the industry relevance of curricula and assignments. This could also involve delivering domain specific learning on specialist courses.

Time frame: Short to Medium-term
Lead: Higher Education Institutes, Companies

- Industry should work with higher education institutes to provide relevant structured work placements for students in analytics programmes and related disciplines.

Time frame: Short to Medium-term
Lead: Employer Bodies, Higher Education Institutes

- Enterprises in data analytic business activity should engage with the Irish Research Council's *Enterprise Partnership Scheme* and *Employment Based Postgraduate Programme* whereby Masters and PhD candidates undertake research work of direct relevance to the firm. The value of the schemes should be marketed to prospective companies, students and graduates.

Time frame: Short-term
Lead: Companies, Irish Research Council, Higher Education Institutes

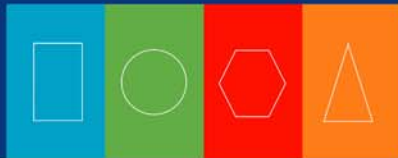
- Expand the provision of short courses to up-skill graduates from science and engineering disciplines. Review current post graduate data analytic course content and work with industry to ensure relevance. Thereafter, course content should be reviewed annually.¹⁰

Time frame: Short to Medium -term
Lead: Higher Education Institutes, Companies

- Business communication skills, critical thinking and project management skills should be taught across all STEM disciplines.

Time frame: Short to Medium-term
Lead: Higher Education Institutes

¹⁰ This review process will be of most relevance to analytics-specific areas. In addition content in areas such as law and corporate governance should be reviewed to ensure relevance to emerging issues in data protection and related developments.



2. Increase the output and quality of Big Data and Analytics Savvy Talent

- Foundation and intermediate statistics and research methods which feature on the curricula of business and social science courses should be updated to include an introduction to emerging analytics concepts and techniques (where this has not already happened).

Time frame: Short to Medium-term

Lead: Higher Education Institutes

- Executive education providers should develop courses in data analytics for decision-makers.

Time frame: Short to Medium-term

Lead: Business Schools, Public & Private Institutes

- Handling data is becoming a core workplace skill and so foundation modules in statistical techniques and data management should be available to law and humanities students.

Time frame: Short to Medium-term

Lead: Higher Education Institutes

3. Deliver relevant data analytic skills - the role of industry

- Improve senior executives understanding of the potential for big data and data analytics to enhance their business performance. An annual data analytics seminar highlighting best practice should be run and company case studies written up and circulated among employers.

Time frame: Short to Medium-term

Lead: Employer Bodies, IDA and Enterprise Ireland

- Firms should adopt an enterprise-wide approach to managing their data analytical capabilities, including the up-skilling of staff and for data protection and governance. Enhanced talent management and retention systems should be promoted. Analytical staff should be offered experience in a range of business functions to gain greater insight of commercial objectives.

Time frame: Short to Medium-term

Lead: Companies

- Industry should support the establishment of an Analytics Skillnet. This should especially target smaller firms and promote the adoption of analytics across sectors. This should be included by Skillnets in the next call for the establishment of new networks.

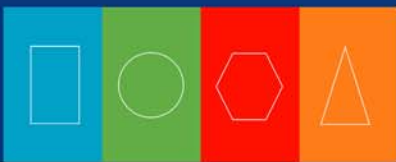
Time Frame: Short-term

Lead: Employer Bodies, Skillnet

- Expand the scale and delivery of flexible, accredited online data analytics course provision.

Time frame: Short to Medium-term

Lead: Public and private institutes, Higher Education Institutes, Employer Bodies



4. Appeal to the broadest potential pool of Deep Analytical Talent

- Employers should develop and communicate appealing career paths for individuals with deep analytical talent. This should include the opportunity to progress to senior data analytics specialist positions as opposed to general management, and lead to accreditation.

Time frame: Short to Medium-term

Lead: Companies, Employer Bodies

- Higher education institutes should utilise all channels to inform employers of the potential skills supply available from as wide a range of disciplines as possible.¹¹ Extensive outreach to students should be encouraged including college campus awareness campaigns and company open days.

Time frame: Short to Medium-term

Lead: Higher Education Institutes, Companies

- Employers and recruiters should emphasise the skills required - as opposed to preferred disciplines - in job postings. This can facilitate qualified applicants from non-typical disciplines.

Timeframe: Short to Medium-term

Lead: Companies, Recruitment Agencies

- Introduce targeted competitive funding available for post graduate specialist analytics programmes to reduce tuition fees, incentivise participation and increase places available.

Time frame: Short to Medium-term

Lead: Higher Education Authority, Higher Education Institutes

5. Promote Ireland internationally as the centre for Analytical Talent

- The employment permit process should facilitate the attraction of skills in deep analytical talent from outside the EU/EEA. These should be added to the High Skills Occupations List in relation to the Green Card Employment Permit.

Time frame: Short-term

Lead: Department of Jobs, Enterprise & Innovation

In addition to recommendations made in this report, policy in this area will be reinforced with the implementation of two actions proposed in the EGFSN/Forfás study on High-Level ICT skills:

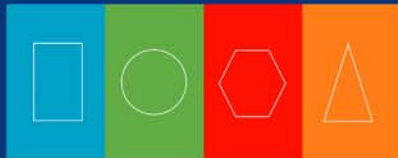
- Establish a single website with public and corporate involvement to proactively attract international talent.

Lead: Enterprise Ireland, IDA Ireland, Companies, Department of Social Protection (EURES)

- Organise career fairs abroad to attract high-level talent from abroad including expatriate talent, with a group of companies with actual jobs to fill.

Lead: Enterprise Ireland, IDA Ireland, Department of Social Protection (EURES), Companies

¹¹ Along with STEM graduates, these will include, but not be limited to, the quantitative and computational social sciences, geography, life sciences and other areas where candidates have undertaken advanced quantitative training.



6. Inspire the next generation of Analytics Talent

- Enterprises should write up and make accessible case studies providing tangible information of career paths and interesting roles available in data analytics. Careers guidance in schools should communicate the availability of career opportunities in analytics to students (particularly females), parents and teachers. The problem-solving nature of analytics should be highlighted.

Time frame: Short to Long-term

Lead: SFI Discover, IDA Ireland, Enterprise Ireland, Companies

- Industry, higher education and awareness bodies should work together in collaboration with networks such as Coder Dojo to provide data analytics related project work such as the Apps4Gaps competition for young people.¹²

Time frame: Short to Medium-term

Lead: SFI Discover, Higher Education Institutes, Companies

- Existing initiatives such as the *Smart Futures* programme should be used to communicate and promote analytics careers information to post-primary students, teachers and parents.

Time frame: Short to Medium-term

Lead: Companies, SFI Discover, Engineers Ireland

- An Analytics category should be added to the four existing categories in the *BT Young Scientist and Technology Exhibition*.

Time frame: Short-term

Lead: BT Young Scientist and Technology Exhibition

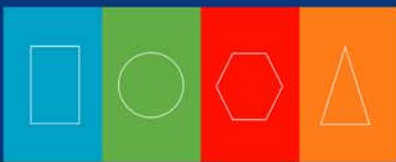
7. Measure progress in Big Data and Analytics employment

- Industry and State Agencies should work with the CSO and Revenue Commissioners to explore the possibility of further developing official measures of big data and analytics employment.

Time frame: Medium to Long-term

Lead: CSO, Revenue Commissioners, Forfás

¹² Apps4Gaps is run by the INSIGHT Centre for Data analytics and NUI Galway and is open to primary, post primary and third level students. It invites students to create Apps using open data available from the 2011 census in areas such as transport, housing and planning. Apps4Gaps is a partnership between the Insight Centre for Data Analytics, the Central Statistics Office and Science Foundation Ireland in conjunction with the Department of Education & Skills, the Department of Education Northern Ireland, Project Maths, Coder Dojo and the Digital Repository of Ireland.



Supporting Actions

Alongside the range of skills focused recommendations, a number of supporting actions (related to ongoing initiatives in other areas) are made in relation to unlocking the potential of big data and analytics in the public sector in Ireland

8. Unlock the potential of Big Data and Analytics in the Public Service

- Government bodies should undertake a review of data sources held and make open as much data as feasible. This would also act to encourage the development of groups around the use of open source data and free technologies and stimulate interest in data analysis.

Time frame: Short to Long-term

Lead: Chief Information Officer, Government Departments

- Redouble efforts to build up the data infrastructure including the development of a unique business identifier.

Time frame: Short to Medium-term

Lead: Central Statistics Office

- Enterprises with significant data analytics capacity should be invited to assist Government bodies in carrying out demonstration projects to address specific challenges faced in the public service and illustrate the potential value of big data and analytics.

Time frame: Medium-term

Lead: Chief Information Officer, Government Departments, Companies, Employer Bodies

- Publish examples of successful deployment of analytics in the public services throughout the Government system in order to illustrate the potential benefits.

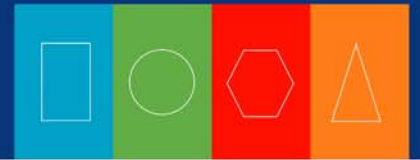
Time frame: Medium-term

Lead: Chief Information Officer

- Consider tailored recruitment to analytics jobs in the public service including academic positions specialising in teaching analytics skills, and the development of a Government Analytics Service to work on a cross-departmental basis to provide solutions to public service problems. An inventory of analytics skills and applications in the public sector should be compiled.

Time frame: Medium-term

Lead: Government Departments



1. Introduction and Overview

1.1 Background

This study, *Assessing the Demand for Big Data and Analytics Skills, in Ireland 2013 -2020*, has been undertaken by Forfás and the Expert Group on Future Skills Needs as an important input to the Government's *Action Plan for Jobs 2013*. The work assesses the demand for data analytics and related skills and proposes actions to address gaps between supply and demand and assist in harnessing the considerable economic and social potential of this area into the medium-term.

1.2 Aim of the Study

The key aim of the study is to understand the likely demand for big data and data analytics skills in Ireland in the years to 2020. More specifically, the work sets out patterns of demand in relation to three distinct categories of skills and competencies as follows:

- *Deep analytical talent* - requiring a combination of advanced statistical, analytical and machine learning skills.
- *Big data and analytics savvy roles* - individuals at all levels of a business or organisation with an understanding of the value and potential for exploitation of big data and data analytics.
- *Supporting technology roles* - personnel with the skills to develop, implement and maintain the hardware and software required to make use of big data and data analytics.

The project aims to understand the types of skillsets in highest demand and understand current and planned programme provision in terms of anticipated demand.

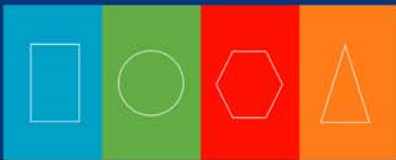
The project's ultimate objective is to advance recommendations on measures to build up the big data and data analytics talent pool through domestic graduate output, continuing professional development within industry, and, where necessary, attraction of talent from abroad - including expatriate talent.

1.3 Approach and Methodology

The research and analysis set out in this report draws on a wide range of analytical techniques and sources of information, both qualitative and quantitative in nature. In addition, the findings benefit from the views of a broad spectrum of stakeholders across industry, Government and academia. The analysis also takes into account discussions and inputs during several meetings from members of the Steering Group set up to oversee the progress of the study and the framing of recommendations.

The components of the analysis undertaken include:

- A concise literature review of relevant published material in this area.
- A comprehensive stakeholder engagement including detailed interviews with 55 companies/ organisations and key informants (both domestic and international) across industry and the public sector; and three stakeholder workshops.
- Extensive analysis of relevant labour market data.



- Desk-based research relating to existing and planned educational output of relevance to big data and analytics.
- Review of existing measures and policy approaches in this area, both domestic and international.
- Scenarios development based on both quantitative analysis and informed by qualitative insight.

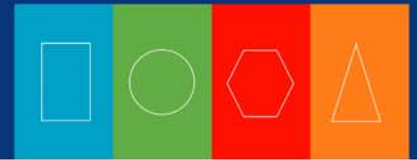
The work was managed by the Forfás Secretariat to the Expert Group on Future Skills Needs and its progress was overseen by a Steering Group made up of representatives from industry, education and relevant Government Departments and Agencies, including IDA Ireland and Enterprise Ireland.

In support of the work, Forfás commissioned EY and Oxford Economics to carry out the stakeholder consultation, literature review, demand scenario analysis and assist in developing the report recommendations. Forfás undertook elements on current and planned provision of data analytics related education in Ireland and an international review of actions taken by a selected range of countries to develop and attract a supply of data analytical talent.

1.4 Report Structure

The structure of the report is as follows:

- Section 2 explores a range of recent and emerging developments in the area of big data and analytics which will impact the business environment and resulting demand for skills in the period to 2020.
- Section 3 draws on international experience and Irish-economy analysis to arrive at an estimate of the existing baseline of employment in big data and analytics related roles in 2013.
- Section 4 sets out the findings of the consultation phase undertaken for the study. This includes a detailed analysis of responses to the interview-survey undertaken with 55 companies, organisations and key informants and key themes emerging from three stakeholder workshops.
- Section 5 presents scenarios in relation to future demand for analytics talent. These include low, moderate and high growth scenarios predicated on various assumptions.
- Section 6 discusses the international literature in relation to big data and analytics skills supply and outlines a comprehensive inventory of domestic big data and analytics related educational programmes and current output under these courses.
- Section 7 describes a range of policy measures in place internationally and domestically to assist in driving the supply of big data and analytics skills.
- Finally Section 8 concludes and presents a set of recommended actions to improve the quantity and the quality of data analytics skills to assist in driving the economic potential of this area for Ireland.



2. Big Data and Analytics - Drivers of Change

2.1 Overview: Defining Big Data and Analytics

The purpose of this Section is to outline observed and likely future developments in the business environment which will inform the medium-term demand for big data and analytics skills.

While big data and data analytics have gained prominence in recent years, there is no single, internationally recognised definition of 'big data' and no operational definition that can be used to determine market or skills development.¹³ Although there is no uniform definition of big data activities, a degree of consensus is evident in the widespread use¹⁴ of the '3Vs' which define big data in terms of the 'volume, variety and velocity' of data:

- Volume - referring to data stores of petabytes or above;
- Variety - referring to diverse formats of data generation sourced from various mechanisms; and
- Velocity - referring to the requirement for real time collections/analysis of data.

The term 'big data' has been devised to describe the exponential increase, obtainability and use of information in both structured and unstructured forms. The upsurge in big data has been driven by escalating volumes of detailed information originating from companies and enterprises, mass media and multimedia, social networking platforms and the 'Internet of Things'. Data analytics, the analysis of large (and small high value) data sets, has become a fundamental element for both private sector and public sector organisations who wish to compete through ever evolving technology, productivity advancement, innovation in research and development.

For the purposes of this study, data analytics is understood as the mining, analysis, interpretation and purposeful utilisation of data, including big data. This process of extracting and analysing data has been noted as a key requirement for organisations across all sectors in terms of the value to be economically extracted.

2.2 Deriving value from Big Data and Analytics - Key Drivers

With increased availability of information about customer preferences and actions, production processes and supply chains, there is growing recognition of the economic returns from the use of big data and analytics. Research conducted in 2012 found that there was an incremental return on investment in big data of more than 200%.¹⁵ A recent report has stated that business benefit can be gained by creating systems that convert information into actionable insights, all within the context of key business priorities. The types of activities include:¹⁶

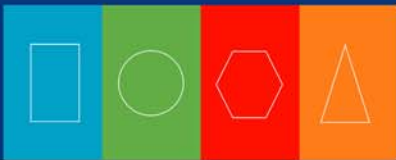
- Finding and accelerating growth opportunities – drawing on internal and external data to help model and predict business outcomes, identify the most profitable opportunities and differentiate businesses from their rivals.

¹³ e-Skills UK, (2013) Big Data Analytics - an assessment of demand for labour and skills, 2012-2017.

¹⁴ See Hagstrom, M., Manocha, I. (2013), The Big Opportunity for Inclusive Growth in World Economic Forum (2013) Global Technology Report 2013; Intel (2012), Big data analytics, Intel's IT manager survey on how organisations are using big data; E-skills UK, (2013), Big Data Analytics- an assessment of demand for labour and skills, 2012-2017; IDR (2012), The digital universe in 2020: big data, bigger digital shadows, and biggest growth in the Far East.

¹⁵ Nucleus Research (2012) - "The big returns from big data".

¹⁶ EY (2013) Predictive analytics - The C-suite's shortcut to the business of tomorrow.



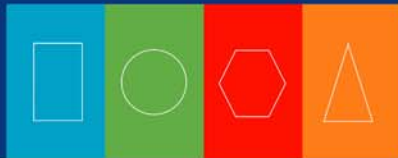
- Improving business performance – enabling agile planning, more accurate forecasting, better budgeting and trusted decision-making support.
- Managing risk and regulatory pressures – improving reporting processes through the exploitation of more robust data, while also identifying potential risk areas, such as compliance violations, fraud or reputational damage.
- Exploiting emerging technologies – continually identifying new opportunities.

Analysis undertaken for this project assesses the particular trends across business sectors. Table 2.1 highlights a range of applications which will shape the developments in the years to 2020.

Table 2.1 Examples of Sectoral Applications of Big Data and Data Analytics

Sector	Developments driving growth in analytics applications
Insurance and Financial Services	Dealing with ever-increasing amounts of digital information will require a combination of semantic and big data technologies to provide the ability to manage assets. Financial institutions can leverage information to augment understanding of markets and meet evolving regulatory demands.
Transport	Transport operators realise the need to better understand their customers using social media and cloud based data to engage, service and retain them. Sensor technology on HGV vehicles can tell important information about maintenance, load balance, safety, tracking and route optimisation.
Healthcare	Big data is used to obtain insights to address problems related to variability in healthcare quality and escalating healthcare expenditure. Data sets can include activity (claims) and cost data, clinical data, pharmaceutical R&D data and patient behaviour and sentiment data.
Power & Utilities	There is increased importance of relevance and timing of offerings and interactions based on customer data and insight. Smart metering data will provide improved insights on customer consumption patterns.
Telecoms	Merging customer data with network analytics and location intelligence, improving network performance improvement and optimisation.
Service Providers	Emergence of pure-play analytics services providers with strong analytics domain expertise and technical skills to leverage big data technology and handling of customer analytics projects for large organisations.
Retail	Consumer data offers rich insights into consumer behaviour in regard to a company's products and services creating the possibility for targeted and location based advertising.
Manufacturing	Applications include supply chain and inventory management, energy conservation and process efficiency more broadly.
Government	Analytics applications include reducing fraud, waste and error, case management, crime prevention, improved resource management and asset optimisation.

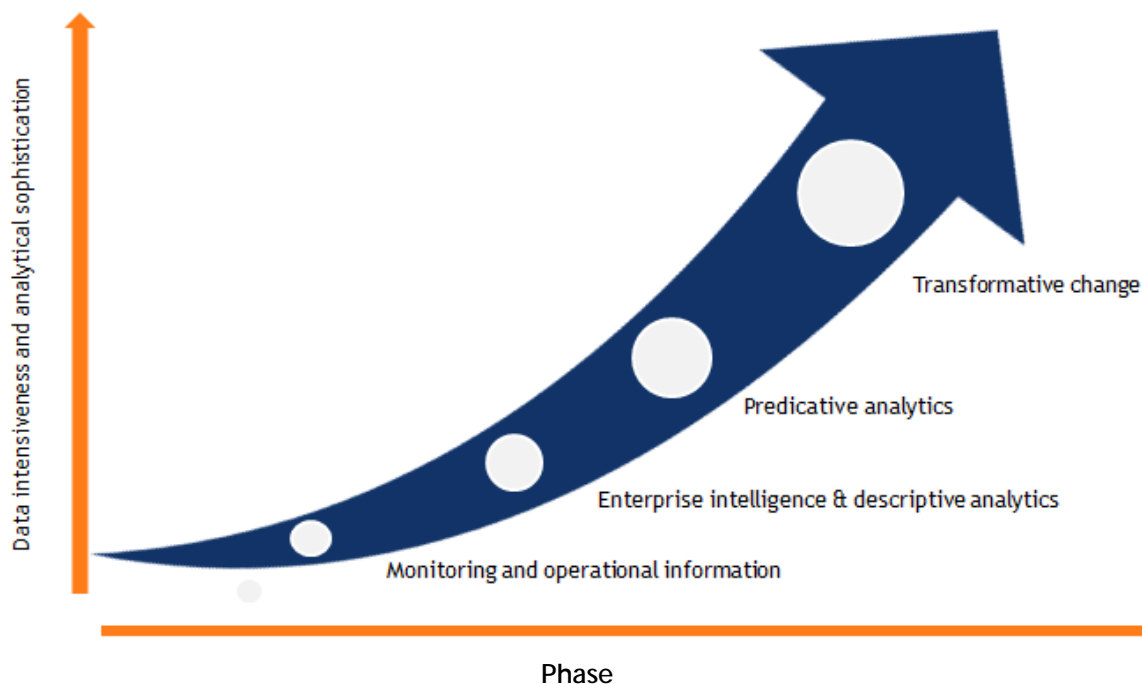
Source: EY



2.3 Patterns of adoption and the power of 'small data'

The research undertaken uncovered a significant degree of variety in the rate of adoption of analytics across business sectors in Ireland and globally. In industries characterised by larger firms and a higher degree of technological sophistication, there is a higher level of data intensity and more advanced and widespread use of analytics. Figure 2.1 illustrates the concept of the 'maturity curve' in relation to big data and analytics. This is derived from a theme discussed during the series of stakeholder workshops for this project.

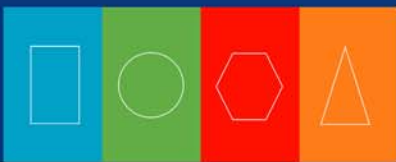
Figure 2.1 Big Data and Analytics: the Maturity Curve



While in general there are divergences in the data intensity and rate of adoption of different sectors, it is also important to recognise contrasting patterns within sectors. For instance major supermarket chains in the retail sector have advanced customer relationship management systems, detailed inventory management processes and revenue forecasting models. Within the same sector, many smaller operators show a slower rate of adoption with data of smaller volume, lower velocity and narrower variation.

Although information held by these companies is not 'big data' there is potential for value extraction and creation through greater analysis. Companies and sectors on the lower end of the maturity curve can benefit from greater interrogation of existing data held for the purposes of understanding customer behaviour, optimising operations and forecasting revenue. In the same way that enhanced use of information and communications technology reached small businesses in the 1990's and early 2000's driving productivity enhancement, greater use of analytics can play a role today. There is therefore benefit to the application of analytical techniques to 'small data'.

Realising the full spectrum of benefits across all firms and industries will require deeper and more widespread appreciation of the potential business benefits available along with a cultural change in organisations leading to better data creation and utilisation.



2.4 Driving Big Data and Analytics in Ireland

The Government's *Action Plan for Jobs 2013* sets out seven 'disruptive reforms' being prioritised with major potential to have a significant impact on job creation, to support enterprises or where Ireland can profit from a natural advantage or opportunity that presents itself in the economy.

One of these goals is to make Ireland a leading country in Europe for big data. To this end, several supporting actions are set out:

- Investing heavily in new research facilities in this space;
- Establishing a new industry-led Technology Centre;
- Commencing new Government initiatives where big data analytics are used to deliver solutions to public service challenges;
- Putting in place the skills needed to sustain this new opportunity; and
- Establishing a joint industry/Government task force to co-ordinate the delivery of these measures.

Over the medium-term, this policy commitment will drive the advancement of big data and analytics.

Recent research focusing on Ireland by the UK Council for Economic and Business Research has sought to model the economic impact of 'unlocking' the value of big data and estimates that greater adoption can add some 2.8% to cumulative GDP in Ireland in the years to 2017.¹⁷ The primary channels through which this is realised are:

- Enhanced business efficiency;
- Greater product innovation; and
- Small business creation.

In the public sector, the last number of years has seen progress with the introduction of unique identifiers, first for individuals (PPSN), and more recently with advances in establishing unique identifiers for businesses. A critical piece of the jigsaw will soon be in place with the introduction of post codes (see Box 2.1).

Box 2.1 Postcodes - illustrating 'late mover advantage'

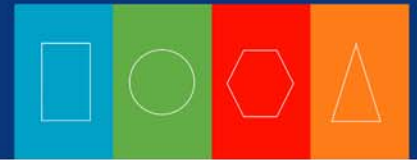
In October 2013 the Government agreed the introduction of a new seven character postcode for every letter box in the country. The system will be in place by early 2015 and will resolve the situation prevailing at present whereby some 30% of addresses in Ireland are not unique.

In some ways, the new system illustrates the potential of 'late mover advantage': although developed countries have had post code systems in place for decades, the Irish model will be the first in the world to use a code that is unique to each individual address.

The many advantages will include more rapid access for emergency services, more efficient postal operations and better planning of public services.

The new system can be seen as the 'third leg of the stool' following on from the introduction of unique personal identifiers coupled with progress in establishing unique business identifiers in recent years.

¹⁷ Cebr (2013) Data equity-Ireland. Unlocking the value of big data.



In October 2013, the Government announced a number of measures to accelerate open data at a summit of the International Open Government Partnership. A number of important developments were announced including:

- Signing up to the G8 Open Data Charter, the international standard for open data;
- Establishing an Open Data Board in order to oversee effective data governance;
- Building an Open Data Platform; and
- Setting up an Open Data Steering and Implementation Group to carry out or commission the necessary actions such as overseeing the timely and effective publication of data on the Open Data Platform.

A number of specific actions to build upon these commitments are included in the Government's Action Plan for Jobs 2014. These actions, to be implemented in 2014, are:

- Launch an Open Data initiative, which will include the establishment of an Open Data portal to act as the primary source of public sector datasets, in the context of Ireland's membership of the Open Government Partnership.
- Further strengthen the mechanisms for data sharing and the use of data analytics across Government by enacting the required legislation, setting up a platform to facilitate data analytics within Government and taking steps to strengthen further Ireland's data infrastructure.

These initiatives offer the potential to drive innovation and economic growth and strengthen performance in the delivery of public services. An important policy objective is to create a culture in which public service data is widely available and usable.

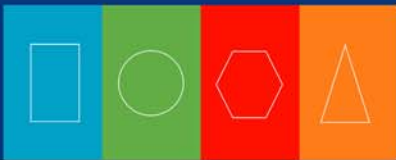
Added to these domestic drivers, the prospect of building up a significant base of exporting firms - both through FDI and the indigenous cadre of companies - offers major potential to spur analytics growth in Ireland. Despite difficult trading conditions since the onset of the global downturn, Irish export performance and attraction of new FDI to Ireland have shown remarkable resilience. This performance has been built upon Ireland's long-established business strengths including skills availability, proximity to major markets, productivity and a favourable business tax environment. These factors continue to be in place and will assist in building a reputation as a centre for data analytics.

This section set out the types of developments which are promoting an enhanced appreciation of the value of analytics and, in turn, a faster pattern of adoption of analytics globally. Enterprises in Ireland will be well placed to take advantage of these developments and export analytics services. In addition, Ireland can capitalise on the growth in global analytics service providers and aim to target the attraction of more such firms.

In this regard, Ireland will be aided by the presence of a number of global brands in this area and the reputation established in the ICT sector - a closely related area of business activity.

2.5 Potential constraints

At the same time, a number of factors may conspire to limit the adoption and speed of uptake of big data and analytics. The availability of appropriate skills in itself has been cited as one of the



most significant constraints of big data and data analytics activities in various research contributions.¹⁸

Recent analysis reported that over the next ten years, ever reducing data storage costs coupled with major growth in data availability will mean that companies must make choices in relation to which data to keep and which data to ignore through a process of evaluation. While vast reams of data contain nuggets of information that can help businesses deepen their understanding of markets, customers, products, supply chains, competitors and risks, blindly applying analytics without understanding the individual business benefit is pointless and will lead to unsatisfactory results.¹⁹

In Ireland in particular, a number of themes have emerged during the research which may act to curtail the growth of big data and analytics:

- Adoption of data analytics techniques has been slower in public bodies than what has been observed internationally - although this can be expected to change with the types of developments in train in relation to open data, postcodes and other advances.
- Despite recent cause for optimism in the wider economy, a continued level of uncertainty about medium-term prospects could impact negatively on the investment required.
- There is a chance of a tightening of EU Data Protection regulatory requirements and more stringent rules regarding data privacy, data sharing and related issues.

2.6 Implications for Skills

Notwithstanding the potential constraints noted above, the weight of evidence suggests dynamic growth in the demand for big data and analytics related skills both globally and domestically in the years to 2020.

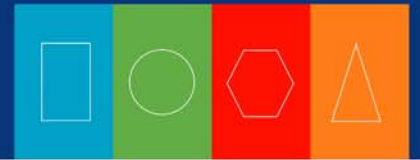
Increased recognition of the potential commercial benefits of the adoption of analytical techniques coupled with the continued growth of data protection will drive this. There will be many implications for skills including the need for:

- The right quantity and quality of advanced quantitative ability;
- The right mix of analytical and sectoral or 'domain' knowledge;
- Supporting skills both from a technological perspective and legal and management skills in areas such as data protection, privacy and governance; and
- Communications skills to be able to translate insights from analytics in order to realise commercial gains.

The following Section sets out the baseline position in relation to existing skills demand.

¹⁸ Economist Intelligence Unit, (2012) Big data, lessons from the leaders; Hagstrom, M., Manocha, I. (2013) The Big opportunity for inclusive growth in World Economic Forum (2013) Global Technology Report 2013; McKinsey Global Institute, (2011) Big data: The next frontier for innovation, competition, and productivity. The scenarios developed for this project and set out in Section 5 assume that skills availability is not a constraint.

¹⁹ EY (2013) Performance Volume 5, issue 3.



3. Existing employment demand in Data Analytics in Ireland

3.1 Approach

A key input to assessing likely future demand for skills in big data and analytics is an understanding of existing employment demand in relevant roles. From this baseline, forecasts of how skills demand may evolve can be made based on an analysis of wider domestic and global drivers and constraints in this area.

Big data and analytics is a relatively recent area of business activity characterised by rapid growth. Notwithstanding the myriad opportunities for innovation, productivity and value creation, the newness of this area presents some difficulties for policy makers in understanding existing employment, definitions of roles and related issues.

On account of these factors, it is not possible to measure with absolute precision the existing level of employment demand in this area as might be the case for more traditional occupations or sectors. The approach therefore relies on a number of sources in order to arrive at a reasonable basis for estimating total demand for skills in big data and analytics in 2013. These include:

- Research and analysis from other countries uncovered in the international literature.
- Analysis undertaken to apply estimates in an Irish context.
- Insights from the qualitative research undertaken for the project.
- Analysis of available data for Ireland to assist in understanding the likely sectoral distribution of employment across industries.

Box 3.1 Methodological challenges in estimating employment

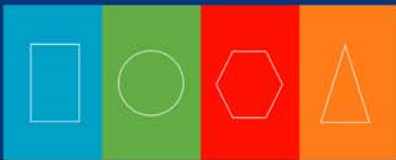
Given a range of issues, estimating existing employment in big data and analytics poses a number of challenges, compared to other sectors and business activities:

- This area is expanding at pace and there are as yet no settled definitions of roles and competencies required.
- Big data and analytics are not strictly a 'sector' as traditionally defined. In practice these skills and activities can be found across retail, utilities, manufacturing, financial services, information and communications technology and a range of other areas.
- Analytics involves a number of new occupations not reflected in traditional official statistics i.e. 'data scientist' and 'chief analytics officer'.
- On the other hand there are many occupations which already exist but don't necessarily require role holders to have extensive ability in big data and analytics. Into the future however, the data explosion will fundamentally alter how business is transacted, resulting in new skills requirements for established roles.

3.2 Existing employment demand - findings from the literature review

3.2.1 Overview

The literature review undertaken for this project identified four studies of potential relevance to assist in estimating baseline employment in Ireland in big data and analytics. These are:



- McKinsey Global Institute (MGI) (2011) Big data: The next frontier for innovation, competition, and productivity (focusing in the main on the US).
- Accenture Institute for High Performance (2013) Crunch Time: How to overcome the looming global analytics talent mismatch (focusing on key sectors in the US, UK, Singapore, Japan, Brazil, India and China).
- e-skills UK (2013) Big Data Analytics - Adoption and Employment Trends, 2012-2017.
- Council for Economics and Business Research (2013) Data equity - Ireland. Unlocking the Value of big data (applying international findings to Ireland).

Each study uses a different framework for classifying the types of skills and competencies required for different roles. The following subsections set out the approach and results of each.

3.2.2 'Big data: The next frontier for innovation, competition, and productivity'

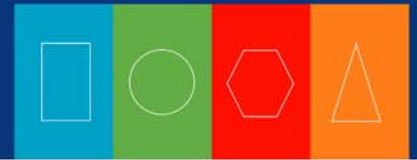
The McKinsey Global Institute (2011) study characterised existing employment in terms of three skills and competency groups. Table 3.1 presents these, and with a list of occupations across each group.

Table 3.1 Role Categories and Occupation Types (MGI)

	Deep Analytical Talent	Big Data Savvy	Supporting Technology
Definitions	People with advanced training in statistics and/or machine learning and who conduct data analysis	People who have basic knowledge of statistics and/or machine learning and define key questions data can answer	People who service as database administrators and programmers
Occupations	<ul style="list-style-type: none"> ▪ Actuaries ▪ Mathematicians ▪ Operations research analysts ▪ Mathematical technicians ▪ Mathematical scientists ▪ Industrial engineers ▪ Epidemiologists ▪ Economists 	<ul style="list-style-type: none"> ▪ Business and functional managers ▪ Budget, credit and financial analysts ▪ Engineers ▪ Life scientists ▪ Market research analysts ▪ Survey researchers ▪ Industrial organisation psychologists ▪ Sociologists 	<ul style="list-style-type: none"> ▪ Computer and information scientists ▪ Computer programmers ▪ Computer software engineers for applications ▪ Computer software engineers for system software ▪ Computer system analysts ▪ Database administrators

Source: MGI

The employment-related elements of the analysis centred on estimating existing demand and likely future demand across each category from 2008 to 2018. The report showed that for the year 2008, 150,000 individuals were employed in the deep analytical talent cohort in the US. Combining this estimate with data from the US Bureau of Labor Statistics for the same year shows that deep analytical talent represented about 0.1% of overall employment. The analysis did not show employment estimates for 2013. However, based on information provided, it can be estimated that



demand corresponds to about 300,000 or 0.21% of total US employment.²⁰ Regarding the big data savvy category, the analysis forecasts considerable growth in demand for employees in the year 2018. While a year-by-year breakdown is not shown, employment in this group can be estimated as corresponding to about 1.8% of total employment in 2013, or about 2,600,000.²¹

3.2.3 'Crunch Time: How to overcome the looming global analytics talent mismatch'

The Accenture Institute for High Performance (AIHP) assessed analytics supply and demand over the period 2010-2015 across a number of countries (US, UK, Singapore, Japan, Brazil, India and China). It focused in particular on oil and gas, pharmaceuticals, banking, insurance, communications and technology, and analytics services. Three categories were used in the Accenture Institute Study with skills and competencies as categorised in Table 3.2.

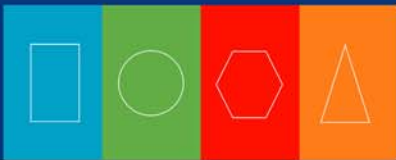
Table 3.2 Role Categories and Attributes (AIHP)

	Analytics Scientists	Analytics Experts	Analytics Specialists
Attributes	<ul style="list-style-type: none"> Individuals designing advanced models to gather insights from large volumes of data. Usually holding PhDs or advanced degrees in quantitative fields, they are experienced in working with large data sets, and embedding analytics in decision processes. They are adept at techniques ranging from trend analysis to predictive modelling, simulation and advanced data visualisation. 	<ul style="list-style-type: none"> Individuals with a deeper understanding of business processes in place and of advanced modelling and statistical skills. Analytics experts translate analytics information into business decisions, often acting as an interface between analytics scientists and business executives. Some analytics experts are primarily business analysts, holding degrees in computer science or MBAs with quantitative orientations. Analytics experts use their insights to recommend strategies and schemes to identify factors like untapped market demand. 	<ul style="list-style-type: none"> Individuals using the output of analytics models and combine it with specialised business knowledge to produce insights applicable to the rest of their organisations. Analytics specialists run complex queries and synthesise analyses as well as prepare reports for the use of decision makers. Although analytics is not the main focus of analytics specialists, a strong background in mathematics or statistics is required.

Source: AIHP

²⁰ Working off the forecast for employment in the year 2018, we have imputed an approximation of the trajectory of employment growth to arrive at an estimate of the proportion of total employment in 2013.

²¹ This estimate is based on assuming straight line growth in forecast employment in the big data savvy category between 2008 and 2018 and assuming that the ratio of big data savvy to deep analytical talent holds constant over the period.



The AIHP report concluded that future demand will exceed supply, in particular for highly specialised analytics roles. Challenges in filling vacancies are forecast to result from shortages in students taking relevant courses and from graduates choosing roles other than analytics jobs upon graduating.

3.2.4 'Big Data Analytics - Adoption and Employment Trends, 2012-2017'

The UK based e-Skills Council undertook this wide-ranging piece of analysis to understand emerging issues in relation to big data and analytics, including forecast employment patterns.

The analysis distinguishes between employment of data specialists and employment of data users.

Table 3.3 shows the types of roles included in the first category.

Table 3.3 Role Categories - Big Data Analytics Specialists (e-Skills)

	IT focused	Data focused
Roles	<ul style="list-style-type: none"> ▪ Strategy/planning/design ▪ Development/implementation ▪ Administration/operations ▪ Support ▪ Other IT focused 	<ul style="list-style-type: none"> ▪ Data Engineers ▪ Data Administrators ▪ Data Analysts ▪ Data Scientists ▪ Other data focused

Source: eSkills UK 2013

The analysis finds 31,000 employed in the UK in the big data analytics specialists category, corresponding to about 0.1% of total employment.

By comparison, the 'data users' group is considered to be much larger, with the estimate of total employment at 383,000, or about 1.3% of total UK employment.

3.2.5 'Data equity Ireland - unlocking the value of big data'

The UK-based Centre for Economics and Business Research (Cebr) recently undertook study on the roles of big data in Ireland²². The study applied the MGI estimates to Ireland from a top-down perspective and cites a total demand figure for deeply analytical jobs of 6,100 in the year 2018.

3.3 Deriving an estimate for Ireland

Ideally, a measure of baseline employment in big data and analytics could be sourced from official statistics and disaggregated across occupation types. For the reasons set out in Section 3.1 this is not possible and so the approach must be to draw on available information from a variety of sources in order to arrive at a reasonable estimate of baseline demand from which to forecast future demand.²³

²² Published June 2013.

²³ In some cases, particularly relating to established occupations of relevance, some CSO data was available. Using special data tabulations prepared by the CSO for the project, this material was used to triangulate elements of the analysis and act as a check on top-down estimates.



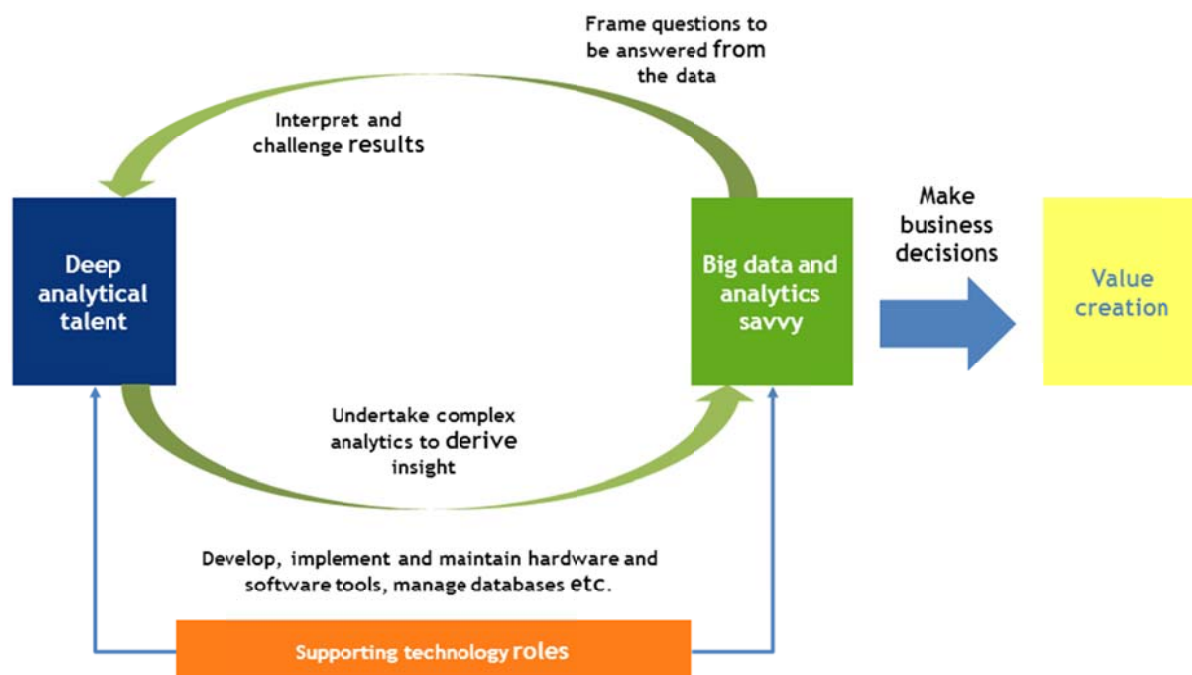
3.3.1 Roles and competency groups

The literature review highlighted a good degree of consistency across estimates of total big data and analytics related employment in the economies studied. While comparable data for 2013 was not shown in all cases, imputing from baselines and growth forecasts shows estimates of existing employment in the region of 1.5% to 2% of total employment. At the same time, the reports reviewed showed considerable variety in the groupings of roles and competencies. For this study, the following broad categories used are:

- Deep analytical talent
- Big data savvy roles
- Supporting technology roles

The advantage of this approach is that it provides a broad cadre of competencies relevant to the area and so is useful in classifying the totality of skills demanded. Where needed, insight from other studies can be incorporated to complement definitions of skills requirements or understand international trends in particular issues. Figure 3.1 shows the relationships between the skills and competency groups and the interrelation of business functions.

Figure 3.1 Interrelationship between Skills and Competency Groups



3.3.2 Applying International Estimates

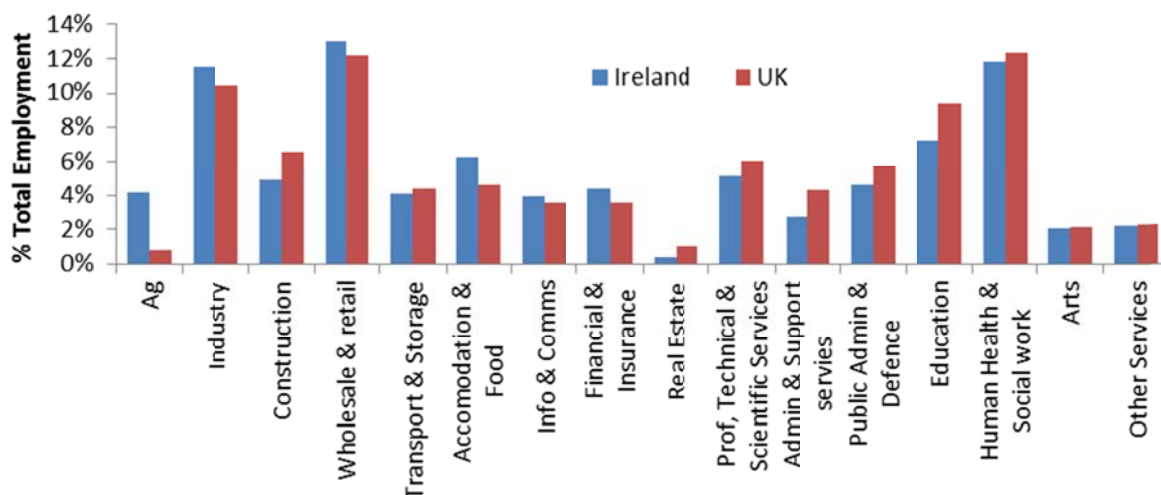
As a starting point, we can understand the level of employment elsewhere (for example in the UK and US) as a proportion of total employment and apply this proportion to Irish data. Box 3.2 assesses the robustness of this approach, drawing on quantitative analysis and qualitative insight.

Box 3.2 Applicability of international demand patterns to Ireland

Crudely applying the proportions of employment derived elsewhere may be overly simplistic. Directly comparable labour market data and feedback from the consultation phase is used to assess the appropriateness of applying UK and US data in the case of Ireland.²⁴

Figure 3.2 sets out the proportion of total employment across each sector of the economy for the UK and Ireland.

Figure 3.2 Sectoral Shares of Employment in Ireland and UK, 2013



Source: EY Analysis of Eurostat data

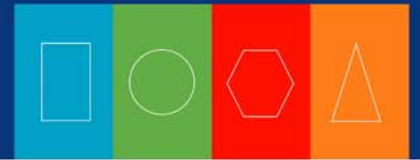
In the sectors of particular relevance in this area, such as information and communications or financial and insurance services, shares of employment are similar or even slightly higher in Ireland, lending a degree of support to the direct application of the UK rates.

Regarding the US, analysis undertaken by Cebr showed similar proportions of employment in high-tech manufacturing and knowledge intensive services which support applying employment proportions.²⁵ Therefore, it can be confidently said that there are no major structural economic disparities which preclude the application of estimates from the US and UK.

At the same time, an issue that emerged during the workshop sessions in the consultation phase of this project is that Ireland is still in the process of catching up with the UK and US with regard to the application of analytics in the public sector and other areas. Existing and planned initiatives by Government will help to bridge this gap. In the interim an approach is to build in a lag period to the application of estimates, for example taking estimates from 2011 and calculating similar proportions of employment in Ireland.

²⁴ The consultation phase consisted of 45 survey-interviews with employers of big data and analytics skills, interviews with ten key domestic and international influencers and three stakeholder workshops held with a wide range of stakeholders.

²⁵ Cebr (2013) Op. cit.



3.3.3 Deep Analytical Talent roles

Starting with the deep analytical talent category, applying estimated proportions for the US and building a slight lag into the Irish estimate (as per the analysis in Box 3.2) estimates total deep analytical talent employment demand in the region of 3,300 in Ireland in 2013.²⁶

A limitation with this approach is that it includes employment associated with 'traditional' or more established analytical roles. Occupations in this category may include actuaries, research economists and analysts involved in the collection and validation of official statistics. While there is no doubt that these roles call for advanced quantitative ability, the employment demand for these jobs is less likely to be influenced by the proliferation of data to the extent that emerging roles like that of 'data scientist' may be. For this reason, applying the type of growth rates envisaged on account of increased data intensiveness to the entire cohort may result in an overstatement of skills demand.

A related point emerged during the stakeholder workshop which echoes this issue. A number of participants felt that roles such as actuaries and economists should be distinguished from other quantitative roles in that much of the type of work was 'model-driven' rather than 'data-driven'.

It may therefore be helpful to distinguish between 'established' *analytical* roles, and emerging *analytics* roles, the demand for which may be more influenced by increased proliferation of data in the business environment characterised by high volume, increased variety and accelerated velocity.

Incorporating other analysis from the international literature can assist in this task.²⁷ Relating US and UK estimates to Ireland based on a top-down application to Irish employment suggests employment demand in the narrower 'data scientist' category of about 1,500.

Utilising CSO QHNS data, an estimate can be made of the level of employment in the more established analytical roles. By their nature, these roles are more settled and therefore some data are available. Most recent information (end-2010) shows that there were 1,300 economists, actuaries and statisticians at work. Based on other data sourced as part of the analysis, this is likely to be an underestimate.²⁸

The weight of the analysis suggests that more than half of the roles requiring deep analytical talent should be considered in the 'traditional analytical' rather than 'emerging analytics' cohorts.

The working assumptions therefore regarding 2013 employment demand in deep analytical talent are:

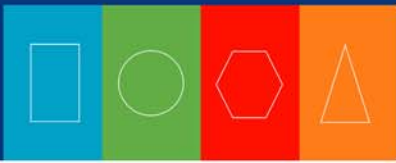
- Employment demand in established analytical roles cohort of 1,800
- Employment demand in emerging analytics roles cohort of 1,500

The assumptions underpinning the scenario analysis in the next section are tailored for each cohort.

²⁶ The approach is to work off the assumed trajectory of employment growth to arrive at an estimate of employment intensity in 2011 (to incorporate a 2 year lag). This gives a figure of 0.18% of total employment employed in roles requiring deep analytical talent. This value is then applied to Irish employment totals to provide an estimate for Ireland in 2013.

²⁷ Specifically, Accenture Institute for High Performance Op. cit.

²⁸ Within this group there are 750 qualified fellows of the Society of Actuaries in Ireland. There are a further 550 actuaries at various stages of training. In terms of economists, given that there have been two rounds of recruitment to the recently-established Government Economic and Evaluation Service in the interim, the total number can be expected to have increased of late. QHNS data may therefore understate the total employed in the 'actuaries, economists, statisticians' category.



3.3.4 Big Data “Savvy” roles

Based on the process of imputing from published work and a top-down analysis, demand in this category of about 25,780 can be estimated. This estimate is arrived at by applying the proportion of total employment in this category in the US to Irish employment data.

For an alternative approach, applying the proportions of total employment from a recent UK study²⁹ produces a result of about 23,000. The group under examination in that work was ‘data users’ who very closely resemble the big data savvy category. This category is described as ‘those using company-specific user tools in their main job (i.e. dashboards/KPI data/market analysis as opposed to built-in, third party tools, like Google search for example)’. Based on these analyses and for comparability with the deep analytical talent group, a figure of 25,780 is used as baseline employment demand in the big data savvy group.

3.3.5 Supporting Technology roles

The available analysis does not show estimates for this category that we can relate to Irish employment from a top-down perspective. Instead the approach is to rely on insights from the survey phase conducted for this project. This work shows that the ratio of deep analytical talent to supporting technology professionals is in the region of 1:4. Applying this ratio to the existing employment demand in emerging deep analytics talent suggest a baseline employment figure of about 6,000.³⁰ This category is a subset of wider demand for ICT professional skills. Many of the issues pertinent to this group were articulated in the Forfás/EGFSN report *Addressing Future Demand for High-Level ICT Skills* (2013).

3.4 The sectoral spread of employment

In addition to the challenges in estimating baseline employment, there are also limitations to understanding the sectoral distribution of existing jobs. To assist with this process, a review of relevant international literature was undertaken.³¹ The approach used was to group industries into low, medium and high data intensity based on their data storage capital stock per firm. Exact corresponding data is not available in the case of Ireland, but as a proxy for data intensity, we have combined CSO datasets to understand the data intensity of industries as the capital stock in computer software per employee. The results are set out in Figure 3.3.

As can be seen, information and communications technology, financial and insurance activities and industry sectors together employ two-thirds of analytical talent. This is consistent with the findings of international research as described in the literature review.

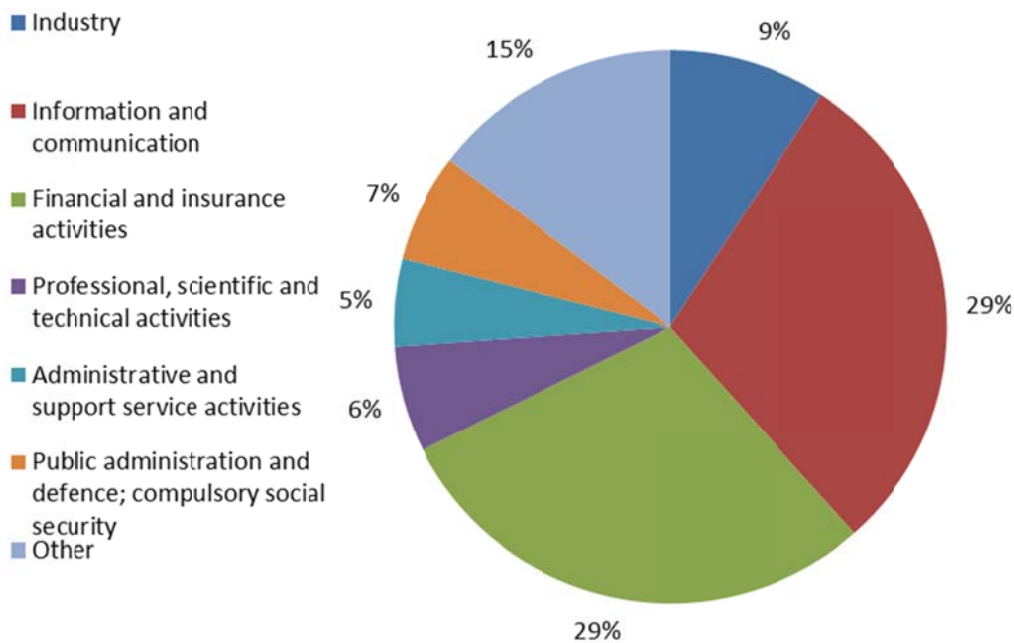
²⁹ e-Skills UK (2013) Big Data Analytics – Adoption and Employment Trends, 2012-2017.

³⁰ In this case the ratio is applied to the ‘emerging analytical roles’ category only. It is likely that the supporting technology functions of the other group are catered for by existing IT roles. As pointed out earlier however, the supporting functions of this cohort extend to both the deep analytical talent and the big data savvy groups.

³¹ Specifically MGI (2011) Op. cit.



Figure 3.3 Estimate of Sectoral Concentration of Analytics Employment



Source: EY analysis of CSO data

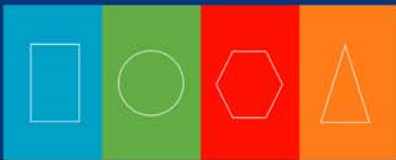
3.5 Baseline Demand 2013

Baseline demand in big data and analytics has been estimated drawing on a range of sources including a review of international literature; analysis of available domestic data relating to the overall structure of employment and to data on established analytical occupations; application of global approaches, adjusting for domestic factors and insight from qualitative research. The results of this analysis are set out in Table 3.4. These estimates act as the baseline from which the future demand scenarios are forecast in Section 5.

Table 3.4 Estimate of Baseline Demand in Big Data and Analytics in Ireland, 2013³²

Category	Employment	% Total Employment
Deep analytical talent	3,300	0.18
<i>Of which emerging analytics roles</i>	<i>1,500</i>	<i>0.08</i>
<i>established analytical roles</i>	<i>1,800</i>	<i>0.10</i>
Big data savvy	25,780	1.38
Supporting technology professionals	6,000	0.32
Total	35,080	1.88

³² These figures represent existing demand across each category. Within this we can expect a level of unmet demand. According to the results of the firm-level interviews there are difficult-to-fill vacancies in the analytics labour market as things stand. The survey interviews showed that there firms had vacancies corresponding to 17% of existing employment in deep analytical talent; 3% in big data savvy roles and 2% in supporting technology roles.



4. Big Data and Analytics - findings from the Consultations

4.1 Introduction

Capturing the views of employers in the big data and analytics sphere is critical to understanding current industry trends and anticipated future developments. To form a balanced view of employment in big data and analytics business activities as well as challenges faced, 55 structured interviews were carried out with:

- 35 enterprises consisting of both Irish operations of major multi-national corporations and indigenous Irish firms. The list of firms consulted included both firms operating across sectors using big data and analytics, and service providers in the analytics domain;
- 7 government bodies including statutory offices, central government departments and state agencies;
- 3 research centres specialising in big data and analytics; and
- 10 key informants - both domestic policy influencers and international industry executives.
- Finally, a series of three workshops was delivered for the project. The workshops heard the views of a wide range of stakeholders in this area, from academia and industry (including specialist service providers, firms in finance and insurance, transport and logistics sectors, wholesale and retail, and manufacturing).

This process allowed the incorporation of views from industry, academia and other stakeholders.

4.2 Survey interviews with employers

4.2.1 Existing employment and demand

Firms were surveyed as to their employment levels across each of the deep analytical talent, big data savvy and supporting technology role categories. Details were collected to provide a breakdown of metrics like gender and age of the analytics labour force as these indicators are generally important in forecasting replacement demand for existing roles.

Figure 4.1 shows that employment in this area is male dominated, particularly regarding the big data savvy category.

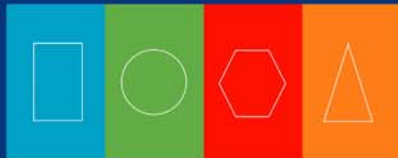
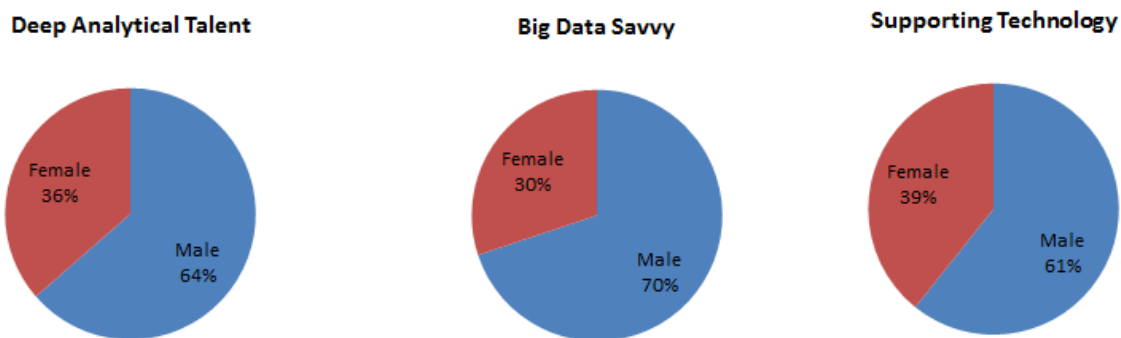


Figure 4.1 Big Data and Analytics Employment - Gender Profile



The average age of role holders across the three categories was also surveyed. Table 4.1 shows the results. Some firms see overlaps between the deep analytical and the supporting technology categories. For instance they rely more on support technology staff who over time acquire the skills required to carry out deep analytical tasks.

Table 4.1 Big Data and Analytics Employment - Age Profile

Role categories	Average Age (years)
Deep Analytical Talent	32
Big Data Savvy	38
Supporting Technology Roles	28

Firms were surveyed in relation to current vacancies. Table 4.2 shows the existing vacancies as a proportion of total employment in each group.

Table 4.2 Vacancies as a Proportion of Current Employment

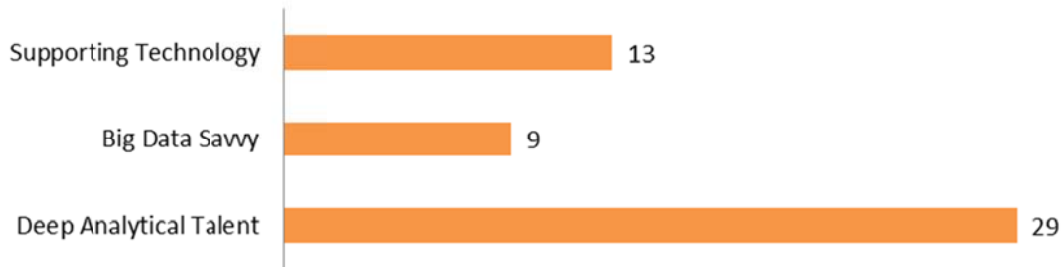
Role categories	Vacancies as % employment
Deep Analytical Talent	17%
Big Data Savvy	3%
Supporting Technology Roles	2%

As can be seen, the most acute instances of unmet demand relate to the deep analytical talent category. This finding is consistent with evidence gathered in the literature review phase.

In relation to challenges in filling vacancies, employers reported a broad mix of factors, with a small number dominating. These are summarised for each skill category below. For the smaller firms surveyed, the main difficulty perceived related to competing with a small number of high profile multinational corporations in attracting and subsequently retaining staff. It was felt that these large companies enjoy better resources as well as strong branding and an attractive youth culture.

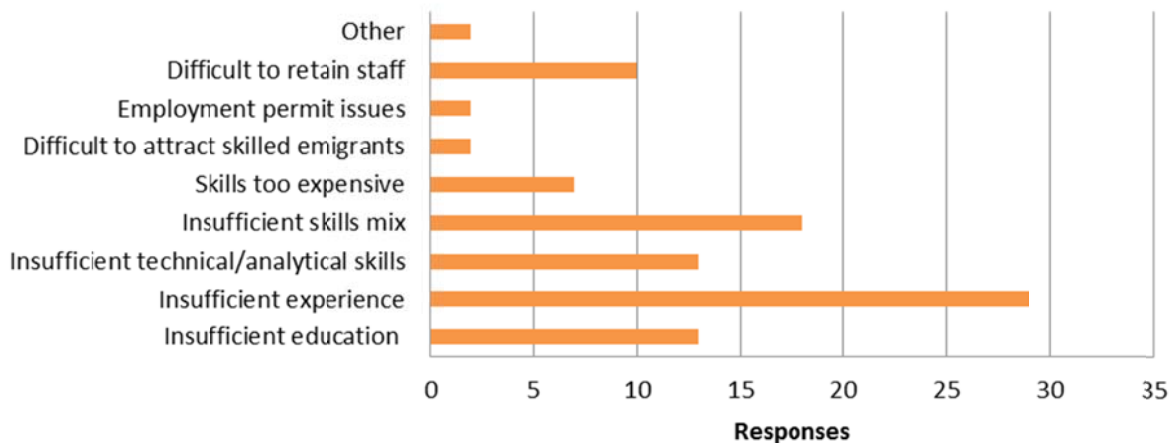


Figure 4.2 Vacancies Hardest to Fill



The majority of those surveyed identified deep analytical talent vacancies as being hardest to fill. However in most cases organisations have experienced difficulty or foresee difficulty in filling vacancies in all three categories. In many cases management has an understanding of analytics but specific technical skills to interpret and use the data are in short supply (C sharp programming skills, data base engineering, data miners). As a result many employers are training existing staff to meet demand. A large number of respondents found it difficult to hire experienced staff while graduates and junior staff were relatively easier to recruit.

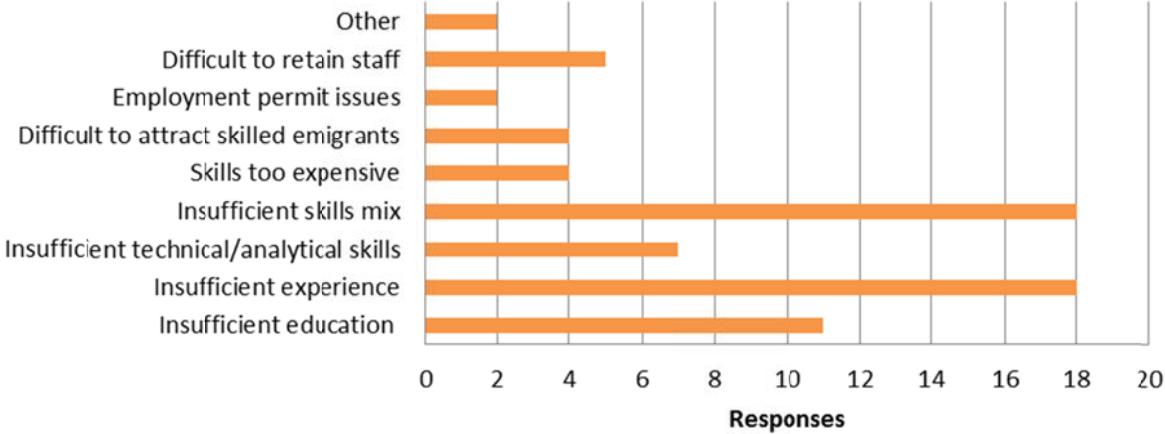
Figure 4.3 Deep Analytical Talent roles - Difficulties Encountered in Filling Vacancies



With regard to deep analytical talent roles, lack of experience, followed by insufficient skills mix is the key issue in relation to filling existing vacancies.



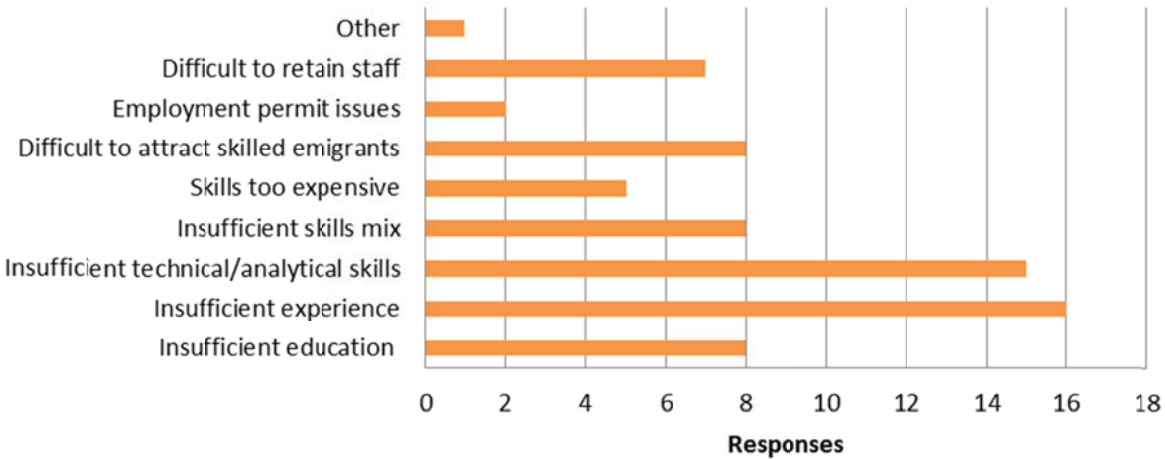
Figure 4.4 Big data Savvy Roles - Difficulties Encountered in Filling Vacancies



As in the case of deep analytical talent, an insufficient level of experience was reported as a barrier to filling vacancies for the big data and analytics savvy group. Some respondents saw this as emanating directly from the newness of the field. In many cases, firms look to up-skilling existing staff as a solution in this regard.

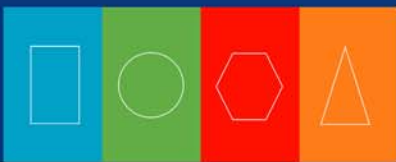
A second major factor reported was an insufficient mix of skills. A common theme was the difficulty in finding persons with a combination of both technical skills and business acumen. Candidates who are capable of interpreting and using data are in short supply. A number of firms report excess demand at present and so companies are competing with each other for staff. Many are hiring from overseas to fill specialised roles; however others consider the skills shortage to be a global issue.

Figure 4.5 Supporting Technology Roles - Difficulties Encountered in Filling Vacancies



Lack of experience and insufficient technical / analytical skills features as a barrier in terms of hiring supporting technology staff. In addition this area suffers from skills shortages more generally experienced in the ICT sector.³³

³³ Forfás and EGFSN (2013), Addressing Future Demand for High-Level ICT Skills.



4.2.2 Anticipated future skills demand

A key focus of this project is in relation to forecasting likely future demand for big data and analytics skills and competences in the years to 2020.

Table 4.3 provides an illustration of the types of technical and business skills identified throughout the consultation and research process as being in demand at present. Interdisciplinary skills are becoming increasingly important. There are also related skill requirements in professional areas including finance, legal, internal audit and risk control. At a more general level, an appreciation for, and competency to use data will become an increasing requirement of individuals' work.

Table 4.3 Illustration of Types of Skills and Competences Required Across Categories

	Deep Analytical Talent	Big Data and Analytics Savvy	Supporting Technology
Technical and analytical	<ul style="list-style-type: none"> Advanced mathematical, statistical and analytical ability NoSQL Data visualisation Web analytics R and other statistical analysis packages Data mining Social media analytics Ability to deal with structured and semi/unstructured information. 	<ul style="list-style-type: none"> Conceptual knowledge, quantitative and analytical skills Data protection, governance, and IP knowledge Enterprise Data management Specific user tools (i.e. dashboards/KPI data/market analysis) 	<ul style="list-style-type: none"> Various programming languages, data related applications and processes Hadoop, Java , C++ , Oracle Building, implementing and managing Hadoop environments Mapreduce Database management and administration - SQL, MySQL, NoSQL
Business and soft skills	<ul style="list-style-type: none"> Communications skills Business acumen Problem solving, creativity , ethics and teamworking skills Domain and sectoral knowledge 	<ul style="list-style-type: none"> Detailed domain and sectoral knowledge Knowledge of social media Business Strategy Project Management Business intelligence Ethics 	<ul style="list-style-type: none"> Communications. problem solving, ethics and teamworking skills Domain and sectoral knowledge Social media technologies Design / user experience skills

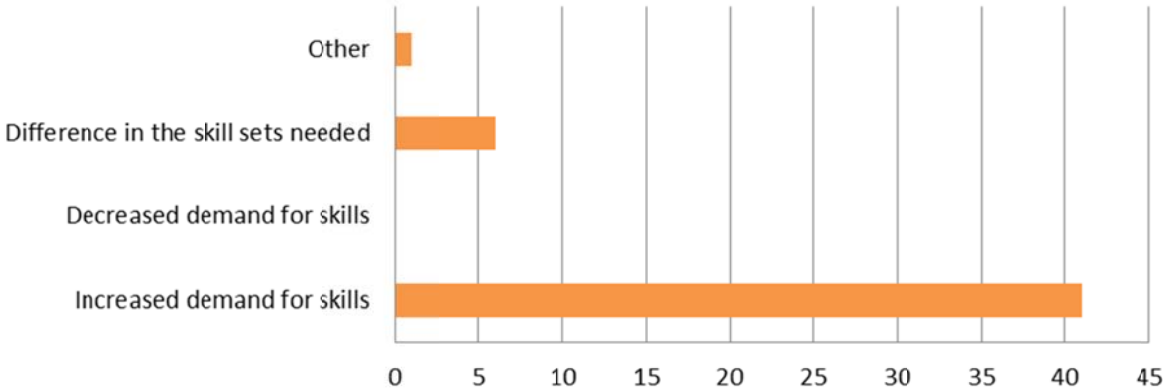
Firm consensus is yet to emerge among companies as to the precise level of qualifications required to fill deep analytical talent vacancies. Some firms reported that a specialist degree in analytics or management science would be an ideal qualification; other companies reported a preference for



Masters' and PhD graduates in quantitative and problem-solving areas such as engineering and maths.

Respondents were surveyed as to their anticipated future demand talent. Figure 4.6 shows firms' headline estimates on future demand trends.

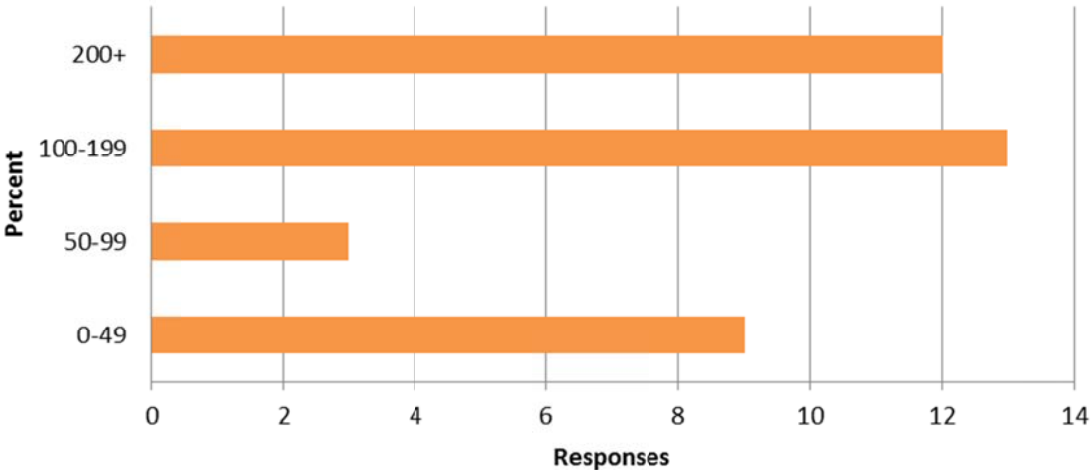
Figure 4.6 Firms' Views on Future Demand for Big Data and Analytics Skills



The majority of firms anticipate an increased demand for data analytics skills into the future, with no respondents forecasting a reduced demand. A small number of firms reported an expectation that the mix of skills would change over the period. One firm expressed the view that demand would grow globally but because of the higher cost base in Ireland, the employment growth would take place elsewhere.

More specifically, Figure 4.7 presents growth levels anticipated by the respondents within their Irish based operations.

Figure 4.7 Predicted Growth in Big Data and Analytics Skills Demand, 2013 - 2020



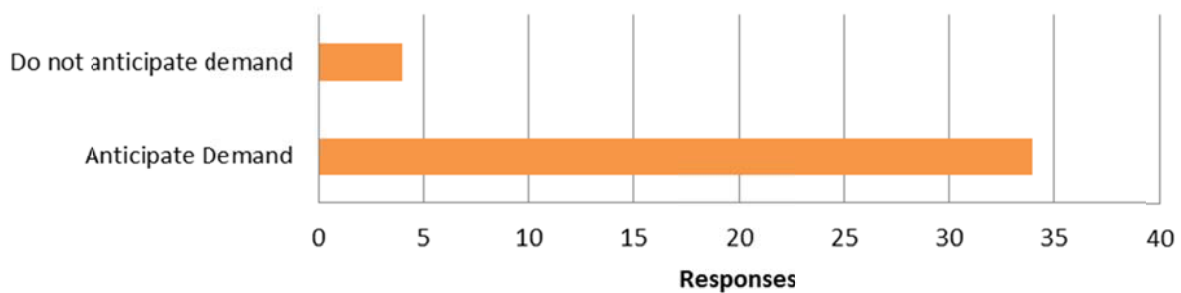
Applying the forecast growth rates of each firm to its current big data and analytics skill cohort and summing the responses gives us the overall growth forecast anticipated by firms surveyed. This shows an increase of just over 100% over the period to 2020.



In addition, respondents expressed views regarding the importance of domain knowledge. The weight of responses found domain knowledge to be relatively less important than pure analytics skills, yet half of firms indicated that it was valuable. This finding was echoed in the stakeholder consultation. A majority of respondents see technical skills as being transferrable from sector to sector while domain knowledge can be developed with internal training and on-the-job coaching. Domain knowledge remains an important attribute for half of employers in this area. For them, effective interpretation of data requires sectoral experience. Often, technically talented individuals lack the business skills required to equate data results to business solutions. For these firms, the response will be to up-skill employees' technical abilities. Interviewees were almost unanimous in their need for technical skills combined with a problem-solving ability; the ability to apply data analytics to come up with domain-specific solutions.

Respondents were also surveyed as to their future demand for skills in supporting professional services. Figure 4.8 shows the results.

Figure 4.8 Future Demand for Supporting Professional Services



The majority of respondents expect an increase in demand for professional services in line with an increased use of big data and analytics but that the number of vacancies will be of a lower magnitude. Data protection and security skills are expected to be required to comply with regulations in various jurisdictions. Data management and documentation skills, internal audit and risk assessment were other skills cited as likely growth areas.

When asked about factors which are impacting on growth in the demand for big data and analytical skills, respondents mentioned a number which are closely interrelated. Foremost were shifts in technology which is generating new trends in markets and changes in consumer behaviour. Market demand trends and internal changes in organisations are also highly ranked. Companies are responding to these factors by effecting changes to their organisations.

EU Data Protection legislation was raised by a number of respondents as a concern as regulatory changes resulting in stringent regulations could stifle innovation in this area.

The economic outlook was identified as both a driver and a potential barrier to growth. In the current low growth environment firms are experiencing considerable pressures to reduce costs and increase value to consumers as a means of increasing market share. Effective exploitation of big data is necessary to remain competitive or to gain an edge over rivals.

Nevertheless some companies fear the costs associated with big data (data storage, accessing social media data) and do not consider it to be a priority for investment. Some respondents alluded to the

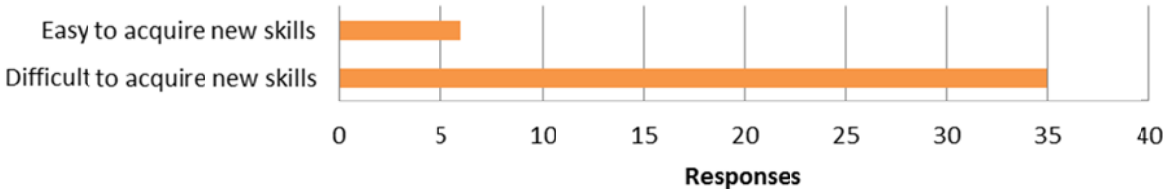


'hype' surrounding big data but the majority acknowledged that once this subsides the true value of data would become evident.

4.2.3 Skills Supply

The survey interview also plays an important role in understanding issues in relation to current and future skills supply. The process found that 85% of respondents who anticipated growth in skills demand expected that suitable talent will be difficult to find in the future.

Figure 4.9 Difficulty Anticipated in Acquiring Suitable Talent

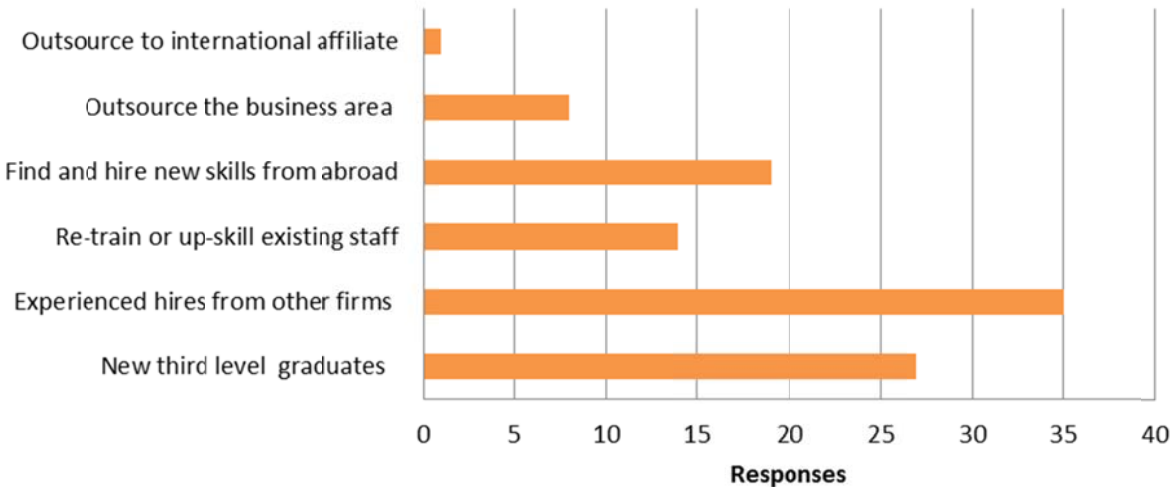


Many companies and public sector organisations are extremely concerned about the skills shortage in this area. However some noted that efforts are being made by the third level sector to increase output in relevant disciplines leading to an increased supply in the coming years. A significant number of firms have hired from abroad and expect to continue to have to do so.

Respondents offered views as to the most likely sources from which future vacancies will be filled, as set out below.

In relation to deep analytical talent, the weight of responses points to new graduates and experienced hires from other firms as being key sources of skills into the future. Figure 4.10 provides further detail. Over the period there will be a flow of talent so that new graduate hires in early years will become experienced hires in later years.

Figure 4.10 Deep Analytical Talent - Anticipated Sources of Future Skills





Regarding big data savvy roles, retraining existing staff is the main channel through which firms envisage building the talent pool. This accords with views expressed during the consultation in relation to big data and analytics savvy talent migrating 'from the domain' into more analytical roles. Many of the types of roles that are within the Big data savvy cohort are already in existence. In these cases, re-training and up-skilling will be critical as the business environment becomes more data intensive. Figure 4.11 provides more detail.

Figure 4.11 Big Data Savvy Roles - Anticipated Sources of Future Skills

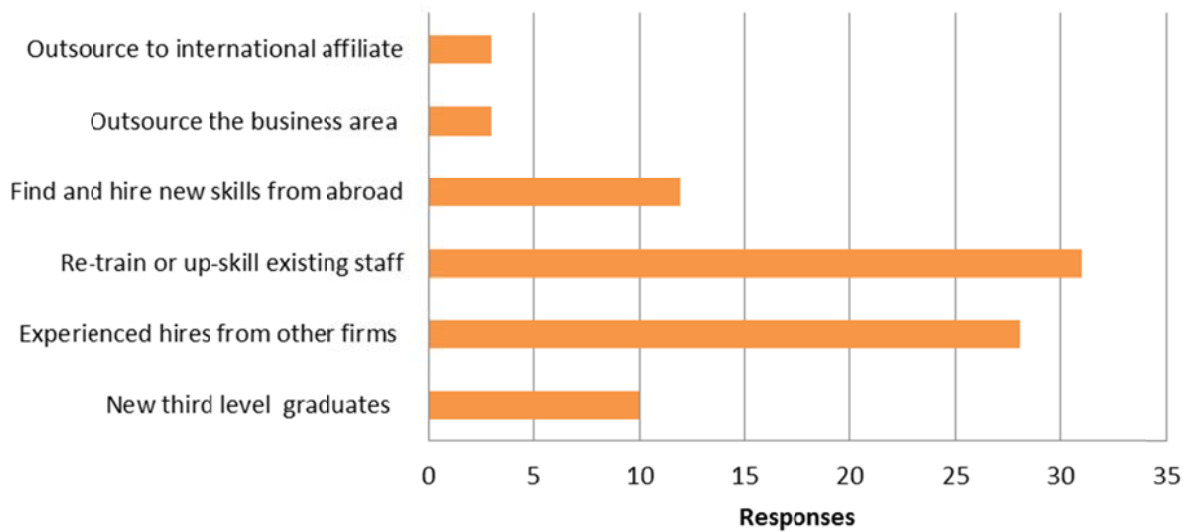
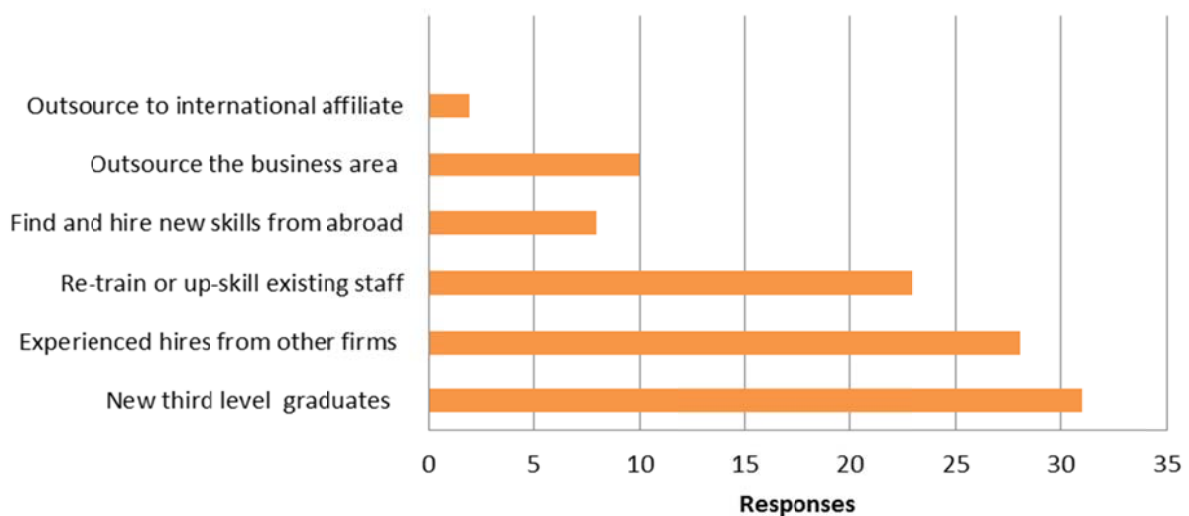
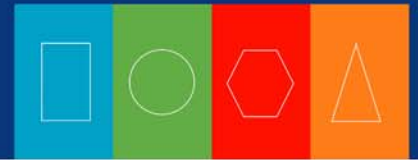


Figure 4.12 sets out the corresponding analysis regarding the future demand for talent in supporting technology roles. A majority of firms anticipate hiring new third level graduates. This is followed by hiring staff from other organisations (job churn). Other main anticipated sources of supply are through the retraining/upskilling of existing staff and the hiring of new skills from abroad.

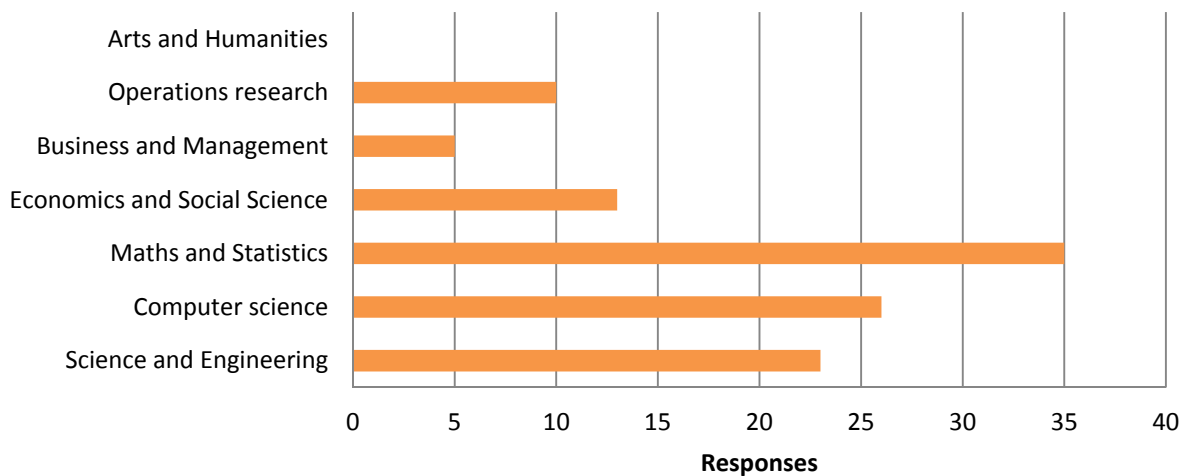
Figure 4.12 Supporting Technology Roles - Anticipated Sources of Future Skills





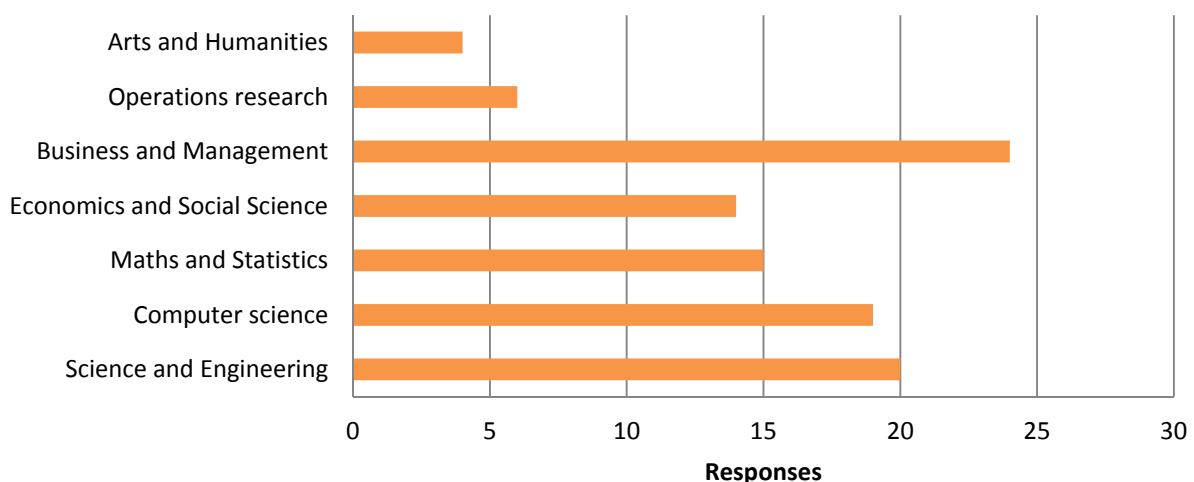
In order to understand implications for skills supply into the medium-term, employers were surveyed in relation to the most likely disciplines from which future vacancies will be filled. As might be expected, maths, statistics and computer science were the most common expected sources of skills for deep analytical talent roles. A significant number of respondents would look to hire candidates at PhD level to fill deep analytical roles. Figure 4.13 shows the position.

Figure 4.13 Sourcing Deep Analytical Talent - Most Common Disciplines



For big data savvy talent, the business and management category dominates. This again echoes the findings of the literature and broader consultation regarding the domain and business focus of these roles. As the use of data and data volumes being exploited increase, staff in business roles will be expected to be much more data savvy. In future those in the data savvy category should be able to 'ask the questions that analysts are currently asking'.

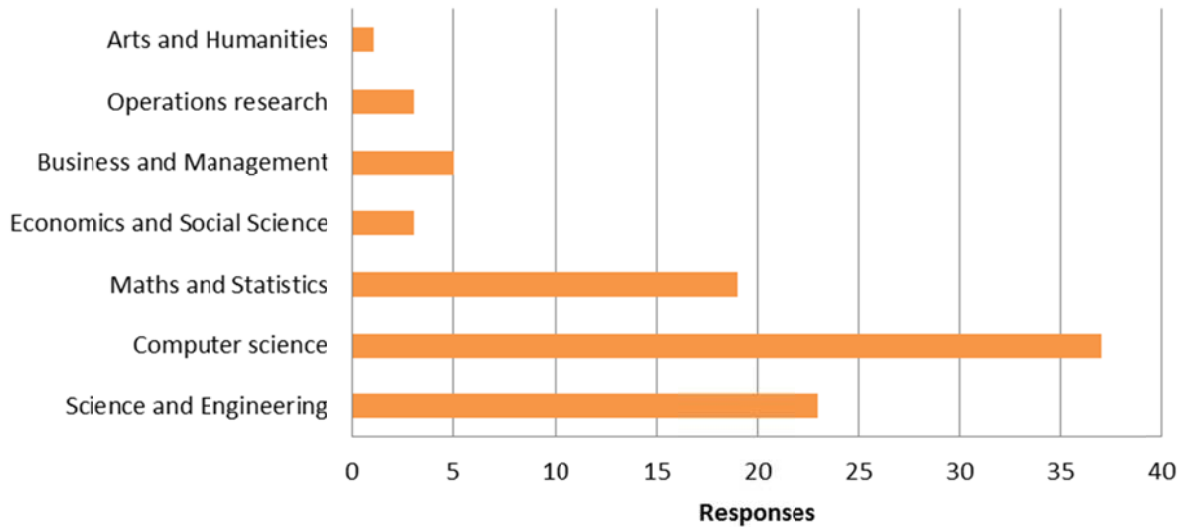
Figure 4.14 Sourcing Big Data Savvy Talent - Most Common Disciplines





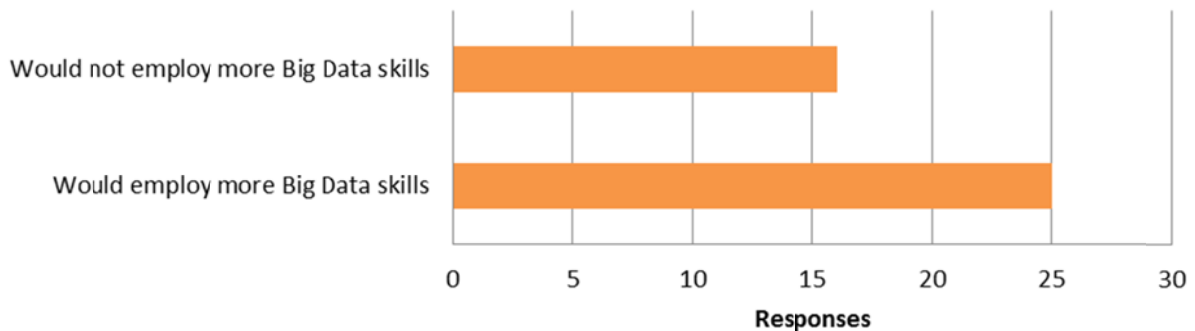
In relation to sourcing supporting technology roles, the computer science discipline clearly dominates, followed by science and engineering.

Figure 4.15 Sourcing Supporting Technology Roles - Most Common Disciplines



Employers were asked if they would employ a greater number of big data and data analytics staff if they were available to hire at present.

Figure 4.16 Likelihood of Employing Additional Data Analytics Staff if they were Available



A majority of respondents stated that they would hire more data analytical staff at present if they were available. For those firms who would not employ more in the short term, many may do so at a later stage. A small number of respondents were training existing staff to meet their needs.

Employers were asked if the current output of the education system meets their needs in terms of the quality and quantity of graduates for each of the three role categories.

In the case of deep analytical talent and supporting technology roles, responses were of a similar vein. While some respondents were critical of the quality of graduates, others have noticed an improvement over the last number of years with postgraduate courses in analytics becoming available. There is greater concern in relation to quantity which is thought insufficient to meet

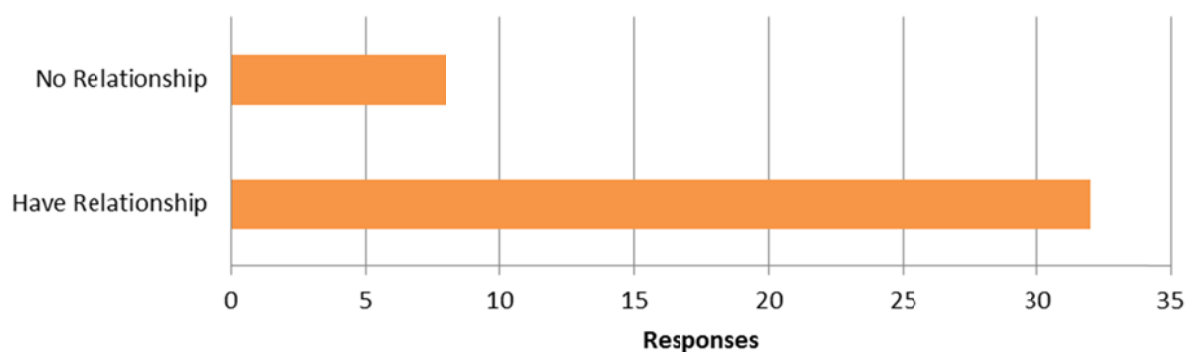


demand. Several interviewees would like to see a more rounded graduate emerge, with a combination of technical ability and business skills.

Employers were not in a position to assess graduate output for the big data savvy roles as this type of position is most likely to be filled by experienced staff. In this regard firms are training existing staff due to shortage of experience on the market.

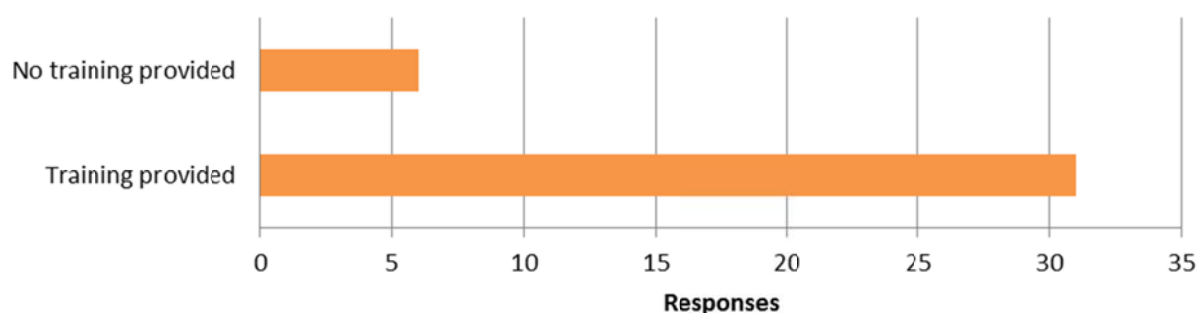
In relation to securing future skills supply, employers were asked as to whether they utilised existing relationships with third level institutes to attract talent to assist filling vacancies. The majority interviewed possess such a relationship. Levels of engagement ranged from having internship programmes in place and attending graduate job fairs to feeding into curriculum design and delivering guest lectures.

Figure 4.17 Relationships with Third-Level Institutes



In addition to skills supply emanating from the education system, in house training and continuous professional development will be important sources of future skills in this area. The survey interview aimed to understand the prevalence of such initiatives.

Figure 4.18 Provision of Training to Employees

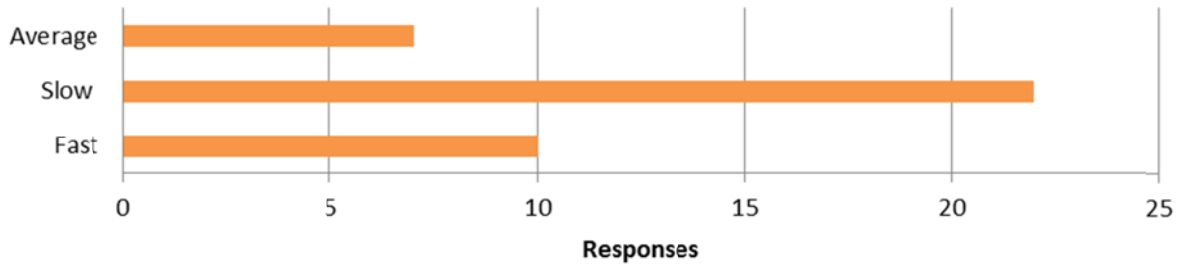


As can be seen, the majority of firms provide training for their staff in this area. However, most only train a core team of specialist staff members engaged in big data analytics. Training initiatives focus on particular skillsets such as on relevant software packages, specialist programming skills and interpretation skills. A small number of companies provide training to all staff on big data.



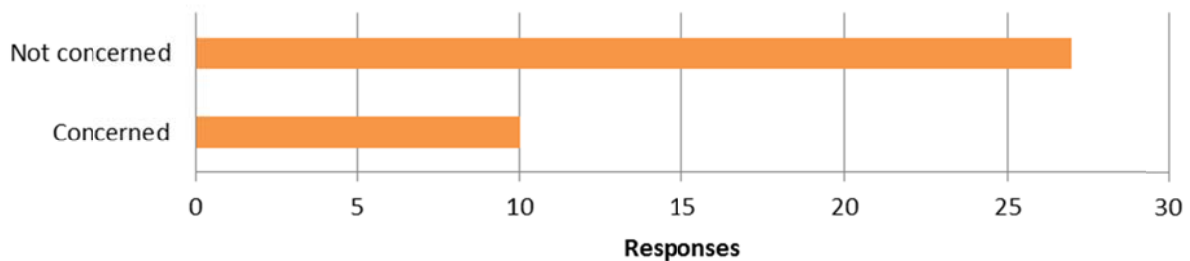
Attrition and churn can be important considerations in high-skilled occupations. Employers were surveyed to see if the turnover of big data and data analytics roles was faster / slower than other roles in their organisation.

Figure 4.19 Turnover of Roles in Big Data and Analytics



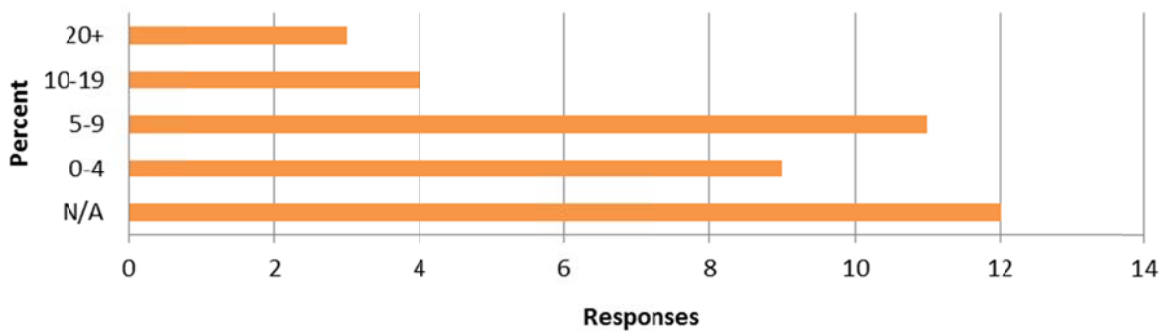
Given the level of churn evident in the Irish labour market at present, firms were surveyed as to whether levels of attrition were a live concern.

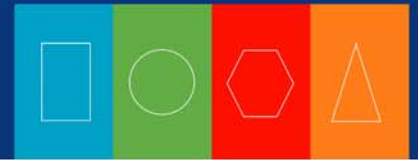
Figure 4.20 Concerns over Attrition Levels



Although a majority of respondents are not currently concerned about attrition, a large number expect this to become an issue in the coming years as demand increases. Smaller companies were more likely to be concerned about employees leaving for large companies with more generous reward schemes. However, while a majority of employers do not report concern over attrition levels, Figure 4.21 shows a reasonably high level in evidence.

Figure 4.21 Percentage of Attrition per Annum





For companies who have hired staff from overseas some expressed a concern about these employees returning home. However the more prevalent view was that Ireland is seen as attractive to foreign staff as a place to live and work.

4.2.4 Proposals advanced

The survey interviews canvassed employers as to the proposals they might make in order to assist in capitalising on growth in this area in general and in order to enhance the talent pool available in particular. A high level of consistency was in evidence during this phase of the consultation.

The types of proposals put forward are summarised in Box 4.1 and help to inform the recommendations developed in Section 8.

Box 4.1 Proposals advanced by survey respondents

Education

A number of proposals were made relating to learning and education. These include that computer skills should be introduced at an earlier stage in the education system and there should be more focus on the teaching of maths at primary level. Regarding the teaching of maths, many respondents advanced the idea that a problem-solving approach should be adopted in second level maths curricula. Greater female participation in analytics should be targeted from an early age.

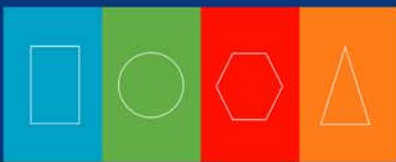
At third level, cooperation between industry and academia is crucial to ensure that education reflects skills needs. Proposals included involving industry experts in devising curricula and teaching analytics on university programmes. Work placements, both in industry and in research centres, should form an integral part of third level courses for students of big data and analytics and collaboration with industry is vital in this regard. In particular the Canadian University of Waterloo model was noted, whereby students are equipped with 24 months of experience upon graduation. Facilitating students on relevant courses to meet people already working in the area to discuss career options is seen as an effective way to attract them to the field.

As a means of raising standards it was suggested that universities with the strongest records in maths and statistics should come together in order to offer specialised courses. Increased funding should be provided for research to support career options for analytics in academia and to drive innovation. Respondents expressed the view that analytical modules should also feature across less technical disciplines, such as business and social sciences.

Steps should also be taken to allow transition into analytics from other disciplines and up-skilling and retraining into the area should be encouraged. To this end, short courses for individuals with technical backgrounds should be provided and be VAT reduced or exempt.

Promoting big data and data analytics

Companies were of the view that arriving at clear definitions of 'big data' is important to improve the appeal of the sector. This would facilitate the development of analytics-related career paths, making a career in this area more attractive. Recruitment agencies' understanding of analytics should also be improved; business associations and representative groups can play more active roles in fostering the area by holding workshops, seminars and awareness campaigns to demonstrate the potential value of data analytics to firms and as a career path.



Public service data is largely untapped as a resource and should be made publicly available. This could act as a catalyst for big data exploitation. Government bodies should undertake demonstration projects to illustrate the benefit of big data and analytics. Sectors such as tourism and agriculture should be prioritised.

Improving Ireland's image

Encouraging participation in relevant courses, promoting analytics as an attractive career and demonstrating tangible success stories of use of big data and analytics will all contribute to improving Ireland's image as a big data and analytics hub. A marketing drive branding Ireland as a location for big data and analytics, where analytics careers can flourish should be undertaken. The R&D tax credit could be made more accessible and better communicated. Skilled workers could be enticed to Ireland and tax breaks offered for firms which employ significant numbers.

4.3 Stakeholder Workshops

As a further input to the project, three workshops were held with key stakeholders in the area. These included:

- Enterprises;
- Industry representative bodies; and
- Academics involved in lecturing on higher education analytics programmes and leading analytics-related research programmes and centres.

A number of key themes emerged, as set out below.

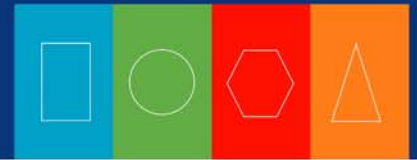
4.3.1 Sectors of relevance

Stakeholders considered sectors where major opportunities exist for the use of data analytics to include financial services, retail/wholesale, ICT, manufacturing, energy and utilities, transport/logistics, healthcare and government. In the case of healthcare, it was suggested that lengthy data recovery times, unsuitable IT systems, the collection on non-standardised data, varying data monitoring standards as well as concerns around the confidentiality of data are hindering increased use of big data and analytics.

4.3.2 Demand issues

It was considered that Ireland generally lags behind competitors in the use of data and analytics by public bodies. Major opportunities exist for use of data analytics in this field. Local authorities have large amounts of data on hand, but this is often of poor quality and underutilised. In addition there are significant opportunities to build on the progress achieved by the Revenue Commissioners. These include the potential for the use of analytics in social welfare fraud detection.

The workshops noted that the correct use and interpretation of big data can create comparative advantage for industry by assessing key areas like customer behaviour and highlighting opportunities. However, it was considered that many firms in manufacturing are not focused on analytics. The application of analytics in retail has gained prominence recently, but mainly at parent company / head office level. SMEs are key players in the analytics market, and fostering their enhanced use of these techniques is important for future investment and innovation. Similarly, start-ups and supporting industries will be able to benefit from an increase in data usage.



The workshops provided highly useful discussion on the skills categorisations proposed. A number of participants felt that roles such as actuaries and economists should be distinguished from other quantitative roles in that much of the type of work was 'model-driven' rather than 'data-driven'.

This discussion inspired the distinction between 'established' analytical roles, and emerging analytics roles, the demand for which may be more influenced by increased proliferation of data in the business environment characterised by high volume, increased variety and accelerated velocity as set out in Section 3.

4.3.3 Skills supply

An accurate understanding of skills needs is important to ensure skill matching. Demand for graduates and new entrants into analytics will be high but up-skilling of existing staff is necessary to meet demand and to ensure domain experience, essential for deep analytical talent roles.

The workshop discussed the options for incentivising participation in advanced mathematics in second level and in courses with analytics components in third level. Participants called for a less risk-averse approach to be taken to education provision in terms of increasing the supply of relevant graduates. In addition, efforts should be made to increase awareness of the potential of big data and analytics which can assist in delivering a labour force with suitable skills and competencies.

Participants noted that in terms of skills supply, a broad array of disciplines should be considered relevant - for example quantitative and computational social sciences at doctoral level.

Box 4.2 Proposals advanced by workshop participants and key informants consulted

Enhancing attractiveness

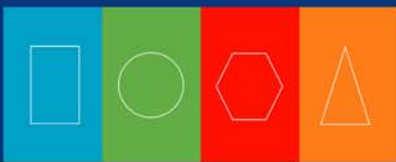
Key informants put forward the idea that support for big data at a community level is key, i.e. that parents understand its importance and potential. In this regard the Coder Dojo model could be used to encourage early teens into analytics. Big data role models from the non-academic realm would also help convince parents and children that rewarding career paths will be available for students taking related courses.

Proposals were put forward to incentivise participation in relevant courses, including Leaving Certificate bonus points for appropriate subjects and waiving fees for analytics-related courses. While more places are required on relevant university courses, entry requirements must be maintained at a high standard.

At the same time, the view was advanced that increased participation in relevant third level courses will not suffice alone to bridge the skills gap; up-skilling and retraining into the sector should be encouraged and incentivised. Similar to survey respondents, stakeholders said that along with the deep analytics skills, the focus should be on improving statistical ability across disciplines (not just in business and general courses, but also in areas such as medicine). In the teaching of third level mathematics, a practical problem-solving approach should be taken rather than a purely academic one. At a company level, firms need to be proactive in engaging staff in continuous professional development to stay abreast of developments. Ultimately they must take a lead role in up-skilling suitable talent.

Promoting big data and analytics

Stakeholder workshops and key informants also called for championing of case studies by Government, i.e. the dissemination of big data success stories relating to Irish companies as



purveyors and users of analytics services. Other demonstration projects could be Government-led, making use of public service data. Major firms in Ireland should be approached to assist in developing these and in enhancing data analytics capacity in the public service. It was suggested that the Revenue Commissions model should be repurposed for use by other Departments. Another approach put forward was to employ small teams of graduates, present them operational challenges to address in areas such as health informatics, agriculture, transport and give them a period of time to come up with a solution. The importance of ensuring high quality output, pursuing excellence in research and of promoting Irish universities globally was highlighted.

4.4 Key Informant Consultations

A targeted consultation phase with key informants on the development of big data and analytics in Ireland was also undertaken in order that high-level perspectives on medium-term prospects could be discerned. Interviews were conducted with two discrete cohorts:

- Domestic influencers in public bodies; and
- Senior decision-makers in the global operations of Irish-based firms in this area.

Findings emerged across a number of themes as discussed in the following sections.

4.4.1 Sectors of relevance

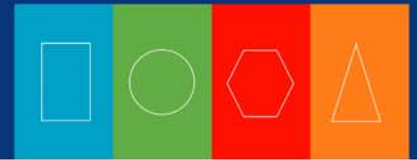
The broad theme that emerged in relation to an analysis of the sectoral concentration of opportunities in data analytics is that in the future, these activities will be relevant across all industries where data are created in significant volumes. At present the use of big data and analytics is greatest in ICT, financial and insurance activities, manufacturing, telecoms, utilities retail/wholesale and to a lesser degree in healthcare, pharmaceuticals, transport and logistics and government. Companies are beginning to interact directly with consumers due to increased usage of mobile devices: many sectors are beginning to behave like retail in their use of data to drive new business.

From a research perspective, Science Foundation Ireland has been funding research in several sectors in recent years. Energy is a particular emerging area of note and improved instrumentation is leading to considerable potential for demand management strategies. Similarly in agriculture, developments with high resolution meteorological data can assist in predicting crop growth. Medical data could have the greatest impact but is most constrained by privacy concerns e.g. applications in optimising the use of radiology, but this would involve patient disclosure issues.

Domestic influencers noted the slower pace of adoption of big data and analytics in Ireland in the public service than elsewhere. With the exception of tax administration, this area is underdeveloped at present. Examples of potential applications were in the Department of Social Protection to assist in fraud detection and risk management and in the health service.

4.4.2 Skills demand issues

Industry leaders were of the view that growth in demand will be most acute in the deep analytical talent group. At the same time, the big data and analytics savvy cohort will be strategically



important. A related view from industry was that the largest demand will be for those with an appreciation of data and analytics, rather than for specialists.

Domestic influencers were of the view that the demand for talent will absorb the supply of domestic talent available. The availability of skills is the key determinant of investment location in this regard and existing clients report difficulties in filling vacancies. In terms of skills levels, informants saw requirements for Masters and PhD level education for many of the roles in the deep analytical talent cohort. There was a view that social science quantitative techniques will need to be adjusted to better align the skillsets of graduates from such disciplines to deep analytical role requirements.

A view was expressed that a major cultural shift is required in the public sector in order to realise capability and potential of big data and analytics. In addition continued expenditure constraint and the public service numbers ceilings could act as a brake on skills demand.

4.4.3 Skills supply

Industry leaders noted that while there is a need to boost the number of people with applied maths skills, an understanding of data more generally for the big data savvy cohort is important. Deep analytics roles require a combination of computer science, statistics and maths skills. Domain knowledge is important but not as fundamental as technical skills and data appreciation.

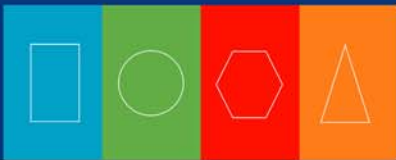
Domestic influencers recognised lags in the education system as an issue: it takes time from when interest is generated in a discipline, to undergraduates enrolling then graduating and ultimately having the right level of experience. This is an inherent challenge. Domestic influencers also saw gaps in the talent pool at present in particular as it relates to the demand for advanced researchers. For existing research teams, while a good number of PhDs can be sourced locally most teams also need to recruit internationally to meet their full complement. At post-doctorate level the challenge is most acute and a key source of this talent is China.

A further supply-side challenge expressed was that while there are many talented individuals with good quantitative skills graduating from the third level system, there is significant competition not just from major analytics employers but also from investment banks and financial firms, as such quantitative skills are highly transferrable. To augment the talent pool, it was suggested there could be a focus on retraining suitable science graduates for roles in this area.

Divergent views were expressed in relation to the absence of clear career paths in big data and analytics, particularly relating to the deep analytical talent group. While one view was that this issue is less important as the types of individuals who choose analytics tend to favour job satisfaction over advancement, a view expressed by domestic influencers was that in small firms, to progress, one generally has to become a manager.

4.5 Concluding comment

This Section has presented detailed findings from the consultation phase undertaken for this project. Taken together, the views set out here represent a comprehensive account of available insights from employers in the public and private sectors, academics involved in the area, key domestic and international informants and a range of other stakeholders. These insights inform the formulation of medium-term scenarios set out the next section and help shape the overall recommendations arising as set out in Section 8.



5. Future demand scenarios for Big Data and Data Analytics

5.1 Introduction

This Section develops future scenarios for big data and analytics talent demand. The scenario method is a useful approach to explore the different ways in which future events may unfold and is one of the most widely used in foresight work. As such, scenarios are not predictions but rather simulations of possible futures. They help to point out the choices and decisions available and their possible consequences. In building out the potential medium-term scenarios, the analysis draws on a range of research and data sources. These include:

- Analysis of global growth projections for big data and analytics employment for other economies such as the UK and US;
- Qualitative insight derived from the company and organisations consultation phase, the key informant interviews and the workshops, and insight from IDA Ireland on potential data analytics greenfield foreign direct investment and
- Analysis of domestic economy sectoral employment forecasts from the EY and Oxford Economics Winter 2013 *Economic Eye*.³⁴

There are a range of factors and uncertainties that will impact on the development of big data and data analytics in Ireland. As a relatively recent business activity- globally and domestically - employment levels are comparatively low today. Different growth scenarios are a result of variations of outcomes including the increase in data intensity both within firms and across the whole economy; the expansion of existing companies data analytics activities; additional inward investment that may be attracted to Ireland-and the enhancement of essential supporting conditions for data analytic business growth. Such variations will have different implications for the volume and nature of big data and analytics talent required, and the potential extent of any talent shortages.

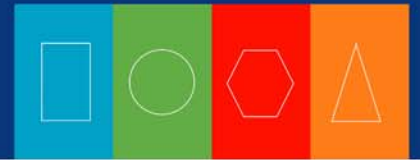
It is therefore important to examine various eventualities through a scenario analysis. Three Irish-specific scenarios are considered for this study in order to understand the range of implications for the demand for and required supply of big data and analytics talent.

This section begins by recapping on the global drivers of big data and analytics growth, and global projections for analytics activities from other economies. This sets the international context and is an informant of likely developments in Ireland. To provide balance, it also outlines downside risks globally before describing the three Ireland-specific scenarios and the different components of big data and analytics demand growth. For each scenario expansion³⁵ and replacement³⁶ skills demand projections are provided, along with up-skilling demand projections.

³⁴ [http://www.ey.com/Publication/vwLUAssets/Economic_Eye_Winter_2013/\\$FILE/EY_Economic%20Eye_Winter_2013.pdf](http://www.ey.com/Publication/vwLUAssets/Economic_Eye_Winter_2013/$FILE/EY_Economic%20Eye_Winter_2013.pdf) .

³⁵ Expansion demand is a technical term used in skill forecasting and refers to the increase in the stock levels of employment.

³⁶ Replacement demand is another technical term used in skill forecasting. This quantifies the number of employees leaving a specific occupation due to a range of factors including retirement, maternity, job-switching and out migration, who consequently need to be replaced without this leading to a change to the overall stock of employment. This does not include job churn where an individual moves to a position in another company within the economy in the same occupation. The sum of expansion and replacement demand represents total new potential job openings. Total talent requirement then equals expansion and replacement demand, plus up-skilling demand.



5.2 Global Big Data and Analytics growth drivers and benchmarks

5.2.1 Key global drivers of big data and analytics skills demand

Globally, there are a number of factors which will influence growth of big data and analytics in the business environment and demand for talent arising. Section 2 discussed a range of these factors. To recap, these include:

- A major increase in the creation and availability of data, driven by the growth of social media, e-government, more widespread use of sensor technology and other factors. This proliferation of information can provide business with valuable insights regarding customers and resource allocation such as data on customer preferences and behaviours, production processes and supply chains.
- A growing recognition of the economic returns from the use of big data. Research conducted in 2012 found that there was a return on investment in big data of more than 200%.³⁷ As companies seek to exploit these returns, the demand for individuals who facilitate data exploitation will increase.
- Analytics can drive business performance by enabling agile planning, more accurate forecasting and better budgeting.

As discussed in Section 2, recent analysis has assessed the business benefit that can be gained by creating systems that convert information into actionable insights. The types of activities include:³⁸

- Finding and accelerating growth opportunities – drawing on internal and external data to help model and predict business outcomes, identify the most profitable opportunities and differentiate businesses from their rivals.
- Improving business performance – enabling agile planning, more accurate forecasting, better budgeting and trusted decision-making support.
- Managing risk and regulatory pressures – improving reporting processes through the exploitation of more robust data, while also identifying potential risk areas, such as compliance violations, fraud or reputational damage.
- Exploiting emerging technologies – continually identifying new opportunities to gain insights from data.

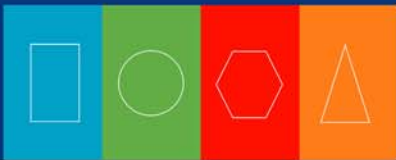
As increased awareness of the achievable business value takes hold internationally, there will be enhance opportunities for firms in Ireland to trade internationally in analytics services.

5.2.2 Global big data and analytics growth benchmark projections

A number of international studies have attempted to estimate the future growth in big data and analytics employment across various geographies and over different time periods. While these studies unanimously point to increased future demand for big data and analytics roles, they differ in terms of the scale of predicted growth overall, and the growth for individual big data and analytics categories. As set out in Section 3 establishing baseline employment, different skills groupings and

³⁷ Nucleus Research (2012) - "The big returns from big data".

³⁸ EY (2013) Predictive analytics - The C-suite's shortcut to the business of tomorrow.



occupation types are also used in the global studies reviewed. Table 5.1 summarises the findings of this analysis.

Table 5.1 Summary of Global Growth Projections of Big Data and Analytics Demand

Source	Geography	Growth Outlook	Period
US Bureau of Labor Statistics ³⁹	US	Employment of particular data analytical support technology roles in the US - such as Computer Systems Analysts, Information Security Analysts, Web Developers, and Computer Network Architects - is projected to increase by 22% over the period 2010-2020. Other big data and data analytics related occupations are forecast to grow at different rates. For example employment of data administrators is forecast to increase by 31% over the 2010-2020 period; employment of computer and information research scientists by 19%; and software developers by 30%.	2010-2020
McKinsey Global Institute ⁴⁰	US	Demand for deep analytical talent roles in the US is projected to reach 440,000-490,000 positions in 2018, from 150,000 in 2008, representing growth of about 190%-225%. Based on current supply trends, demand for deep analytical talent is projected to outstrip supply by 50%-60% by 2018. Demand for data savvy professionals is projected to rise to 4 million positions by 2018. Demand could outstrip supply by 1.5 million by 2018.	2008-2018
Gartner ⁴¹	Global	Gartner project there will be 4.4 million additional IT jobs globally to support big data by 2015, with 1.9 million of these jobs in the US alone.	By 2015
e-Skills Sector Skills Council ⁴²	UK	e-Skills estimate that employment of big data specialists in larger firms in the UK will increase by 49,000 in total over the 2012-2017 period. For larger firms only, it is estimated that this will bring total employment of big data specialists to 69,000 by 2017. e-Skills forecast that employment of big data users in larger UK firms will increase from 383,000 in 2013 to 644,000 in 2017.	2012-2017
Accenture ⁴³	UK, USA, India, China, Japan, Brazil, Singapore,	Accenture forecast annual average growth in big data and analytics skills demand ranges from 1.3% in Japan to 8% in India, with the USA 4.2% and the UK 3.6%	2010-2015

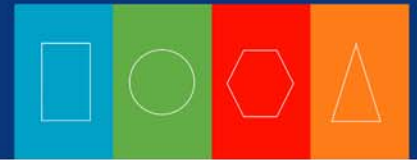
³⁹ U.S Bureau of Labour Statistics (2012), Occupational Outlook Handbook, available at <http://www.bls.gov/ooh/home.htm>.

⁴⁰ McKinsey Global Institute (2011) Big Data: The Next Frontier for Innovation, Competition and Productivity.

⁴¹ Gartner, (2012), Gartner says big data creates big jobs: 4.4 million IT jobs globally to support big data by 2015, available at <http://www.gartner.com/newsroom/id/2207915>.

⁴² E-skills UK, (2013), Big Data Analytics-Adoption and Employment Trends, 2012-2017.

⁴³ Accenture Institute for High Performance (2013) Crunch Time: How to the Overcome the Looming Global Analytics Talent Mismatch.



5.2.3 Downside global risks

While the future demand outlook for big data and analytics talent is generally positive, there are some factors which give reason to be cautious. These include:

- Although international firms and public bodies are increasingly exploiting big data, there can be cases of diminishing marginal returns from the volume of data gathered. Therefore at a particular juncture, the economic case for continued investment in data analytics may diminish, with a follow-on weakening or plateauing in demand for big data and analytics employment.
- Linked to this, there is growing recognition that many corporate and public data consumers no longer face the issue of a lack of volume of data. Instead a lack of relevant, high quality data is the bigger issue. A key consideration for firms will be how to extract more commercially advantageous information to exploit new opportunities.⁴⁴ This can be seen as both a challenge and an opportunity.
- Another important theme which emerged during the key informant consultation process for this study is that big data globally is at, or about the peak of expectation, of the 'hype cycle' regarding the potential value that can be extracted.⁴⁵ This implies that recent rapid global growth in big data and analytics demand may not be repeated on the same scale in future and will slow to more sustainable levels of growth.
- There are also a number of demand and supply side constraints to big data growth globally. On the demand side, not all firms and public bodies, especially SMEs, fully see and understand the benefits of big data and analytics or have sufficient scale and technical capacity to exploit its potential. Therefore future demand from this segment of the economy may not materialise. In addition the sometimes prohibitive level of investment required and high data storage costs may act to temper firms' transition to higher degrees of data intensity.
- Lastly, but amongst the most important factors, on the supply side, a global skills shortage of big data talent is constraining growth. In some ways the sector's development globally is supply constrained. In order to illustrate the potential scale of demand irrespective of supply constraints, the scenarios developed in this section discount talent availability as a barrier to growth.

5.3 Big data and analytics growth scenarios for Ireland

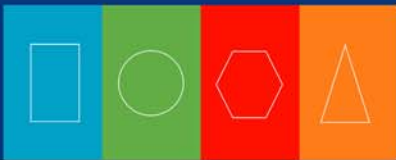
5.3.1 Different components of big data and analytics demand growth

Overall, future demand across the three scenarios and three skill role categories is the sum of:

- Expansion demand;
- Up-skilling demand; and
- Replacement demand.

⁴⁴ Accenture, (2013) Technology Vision 2013.

⁴⁵ The 'Hype Cycle' contends that technological advancements pass through five stages of development - the technology trigger, which spurs a process of rapid growth in visibility to the peak of expectations, followed by a dip to the trough of disillusionment. This stage is then followed by an upward slope of enlightenment which results in the steady stage of the plateau of productivity.



Expansion demand growth will come from:

- Existing organisations, public and private, as they increase in data intensity;
- New greenfield FDI projects; and
- New domestic business start-ups.

From the scenario analysis, the majority of up-skilling requirements will be in the big data and analytics savvy group. This will mainly take the form of transitioning existing managers and data users to learn to interpret and use big data and analytics to better inform decision-making. Based on the company level interviews, there may also be a more moderate level of requirement for up-skilling the deep analytical talent and supporting technology employee cohorts.

Replacement demand will vary across the three role categories based on characteristics such as age structure and attrition ratios. The movement of persons within the same roles between firms in the domestic economy is regarded as job churn and is not included within the replacement demand calculations. A more detailed outline of replacement demand assumptions is given in Section 5.4.3

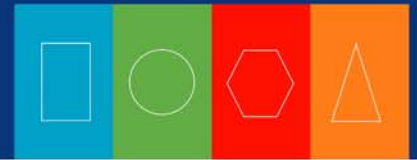
The split of overall demand across the three role categories will vary on a sector and firm-by-firm basis, and whether the source of growth is from existing firms or new greenfield FDI projects or domestic start-ups. More dedicated and specialised analytics service providers are likely to employ a higher proportion of deep analytical talent roles. On the other hand enterprises across sectors who are mainly involved in exploiting their own data for business benefit, are likely to have a higher proportion of big data and analytics savvy roles.

5.3.2 Scenario 1: (Low growth)

Scenario 1 is a minimum low growth scenario where no special demand-side or supply-side effort, public or private, is made to develop and increase the data intensity of economic activities. Under this scenario big data and analytics activity remains under-developed and their full economic and social potential in Ireland is far from realised. Given the weight of current policy focus in this area, the prospect of the outcome of this scenario materialising is very low. Under this scenario, the positioning of the sector in Ireland remains well behind leading countries; Ireland's market share of the global big data and analytics activities remains very low and may in fact decline given competition from elsewhere and outsourcing; there is no further exploitation of big data by organisations, including the public sector; and no new big data FDI projects are attracted, nor are there any major domestic big data and analytics start-ups.

This however does not mean that big data and analytics employment levels will remain flat. Rather, employment is set to grow in line with sector employment forecasts for Ireland from the EY and Oxford Economics latest winter 2013 *Economic Eye* sector projections. However, overall big data employment growth under this scenario is minimal because there is no change in data intensity across the economy and only modest recovery in the economy's wider sectoral employment levels. Total employment across the whole economy is projected to rise from 1.866 million in 2013 to 2.002 million in 2020, an increase of 136,000.⁴⁶ The outcome of this scenario is that Ireland's deep

⁴⁶ The Government's published Medium-Term Economic Strategy (2013) forecasts a slightly higher total employment level for 2020, with aggregate employment just over 4% higher than under the Economic Eye model. The Economic Eye model is used given the sectoral breakdown available which is necessary for the forecast demand exercise to be undertaken.



analytical talent share of total employment changes little and does not catch up with international norms in comparator countries.

The key assumptions of Scenario 1 are:

- No change in the relative share of employment in each sector across the economy made up by big data and analytics roles. This implies no change in the data intensity of sectors and minimal growth in how organisations collect, use and exploit big data compared to today.
- Employment in big data and analytics roles grows in line with the sectors in which roles are mainly concentrated today (principally financial services and information and communications technology).
- Sectoral employment growth is sourced from the EY and Oxford Economics *Economic Eye* model. Forecasts are based on all data available up to and prevailing global conditions and outlooks as of November 2013.

5.3.3 Scenario 2: Delayed catch up (Modest-growth)

The second, modest-growth scenario assumes demand for deep analytic talent roles catches up - after a lag period - with the forecast share of deep analytic employment in the UK.⁴⁷ This scenario is considered far more likely than Scenario 1. A theme that emerged during the stakeholder consultation was that Ireland lags other countries - notably the UK - in the adoption of big data and analytics in some areas. It would be unrealistic to expect this period of catch up to occur overnight, not least given existing tightness in skills supply. But it is more realistic to assume catch-up can occur over a longer period to 2020, providing necessary conditions and measures are in place. Recent initiatives in Ireland, for example, in open data and post codes will assist in this regard.

The key assumptions of Scenario 2 are:

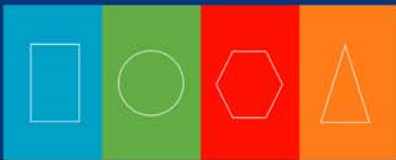
- Ireland achieves convergence with forecast analytics shares of total employment for US and UK.
- The rate of analytics jobs growth picks up pace into the medium-term.
- Growth is achieved via the expansion of big data roles amongst existing firms.

This scenario would be supported by proactive measures supporting big data growth including:

- Greater access to open data and implementation of related initiatives.
- Organisations more fully appreciating and exploiting big data and analytics opportunities
- Greater adoption of analytics in the public sector.
- Ongoing private and public investment in research infrastructure.

All of the additional deep analytical talent employment above Scenario 1 would be in the emerging data-driven analytics roles. This is because the demand for more established analytical roles would be relatively unaffected by this scenario.

⁴⁷ The estimate of the size of the 'emerging analytics' sub-group in Ireland is informed by an analysis of the UK market. This assumes a continued growth in UK data analytics demand over the period to 2020, along the lines estimated by the Accenture Institute for High Performance. When combined with official UK forecasts of overall employment in 2020 this gives an estimate of analytics skills demand as a proportion of total UK employment. This proportion is then combined with the overall employment forecasts for Ireland in 2020 (as set out in the EY and Oxford Economics *Economic Eye*) to derive an estimate the level of demand for 'emerging analytics' roles' in Ireland in 2020. The year-by-year profiles are estimated by presuming slower growth in the short-term, followed by a more rapid catch-up phase into the medium-term.



5.3.4 Scenario 3: Becoming a leading country in Europe for Big data

The third and final scenario represents a high growth scenario for the big data and analytics sector in Ireland. It is based around realising the full domestic growth potential, and Ireland achieving the ambition set out in the *Action Plan for Jobs 2013* by becoming a leading country in Europe for big data and analytics. Scenario 3 is estimated based on forecasts of domestic growth potential from respondents to the structured interview consultation, augmented by potential for expansion in inward investment and other expansion in analytics and big data.

Box 5.1 The Vision

The Government's *Action Plan for Jobs (2013)* sets out an ambitious vision of building on existing enterprise strengths to make Ireland a leading country in Europe in big data. Achieving this status is anticipated to lead to a range of positive outcomes which will:

- Directly and indirectly create high value jobs.
- Strengthen the existing FDI position and attract new FDI from top global organisations.
- Foster indigenous enterprise and innovation.
- Attract and develop top talent in a high value-adding sector.
- Create value through increases in public and private sector productivity.

Under this scenario, there is a marked shift in existing private firm and public organisations' understanding and actual exploitation of the potential of big data and analytics. This may, for example, have to be brought about by a major government and private sector promotion and awareness initiative of the benefits of big data and analytics.

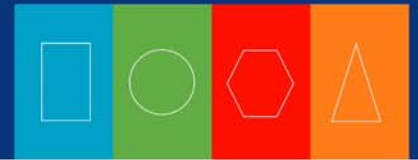
Survey participants anticipate 100% growth in employment over the period to 2020.⁴⁸ This rate of growth is anticipated in relation to the emerging analytics, supporting technology and related big data and analytics savvy roles.⁴⁹ Added to this will be demand arising from new foreign direct greenfield investment and expansions from existing firms into this area and indigenous start-ups.

Under Scenario 3, Ireland would increase its global market share, export more and move towards becoming a leader in big data and analytics in Europe, as it is currently in other sectors like pharmaceuticals and ICT. The profile of future demand for data and analytics roles would, like Scenario 2, gradually increase in the years to 2016, followed by a step-change in 2017 and 2018 and consolidation in 2019 and 2020. This is again justified in the context that Ireland today is still in the process of convergence with international comparators in a number of big data and analytics areas, thereby acting as a brake on rapid expansion in the short-term.

Scenario 3 assumes the implementation of the range of reforms discussed; a continued prioritisation of this area into the future; and an improved culture regarding awareness, support and advocacy for analytics activities among business leaders. The jobs profile of inward investment is assumed to be smooth, but as shown later, an alternative outlook would be a more 'lumpy' FDI profile.

⁴⁸ This growth rate is a weighted average of participants' responses.

⁴⁹ As discussed in Section 3, there is also a cohort of more established analytical roles and related data users which will not experience the same type of dynamic growth. Demand for these skills will grow at a slower pace over the period.



5.3.5 Scenario summary

Table 5.2 summarises assumptions / drivers, interventions / supporting conditions and outcomes for each of the three scenarios. The outcomes for each scenario depend on the drivers and supporting conditions being present.

Table 5.2 Summary of Scenario Assumptions, Drivers and Supporting Conditions

		Scenario 1	Scenario 2	Scenario 3
Drivers	Wider economy baseline sector projections	■	■	■
	Increase in existing firm data intensity to forecast UK and US levels		■	
	Marked increase in data intensity across the whole economy, including the public sector and within a broad range of private firms			■
	Expansion of existing firms' big data activities		■	■
	New, additional greenfield mobile big data FDI attracted to Ireland			■
	Full implementation of measures relating to Open Government		■	■
	Full implementation of measures set out in the <i>Action Plan for Jobs</i>			■
Supporting conditions	No special effort, public or private, to influence the demand-side or supply-side	■		
	Modest boost in domestic big data talent supply and modest improvement in environment for attracting overseas talent		■	
	Major boost in domestic big data talent supply and improvement in environment for attracting external talent			■
	Removal of barriers to domestic big data growth such as greater access to open data		■	■
	Widespread adoption of data analytics in the public sector			■
	Significant improvement in Ireland's big data international competitiveness offering, especially versus European competitors			■
Outcomes	No change in economy-wide data intensity from today's level	■		
	Decline in Ireland's global big data market share	■		
	Ireland's global big data market share converges with other countries		■	
	Exploitation of domestic big data opportunities amongst existing organisations, public and private			■
	Rise in Ireland's global big data and analytics market share			■
	Ireland becomes a leading country in Europe for big data and analytics			■

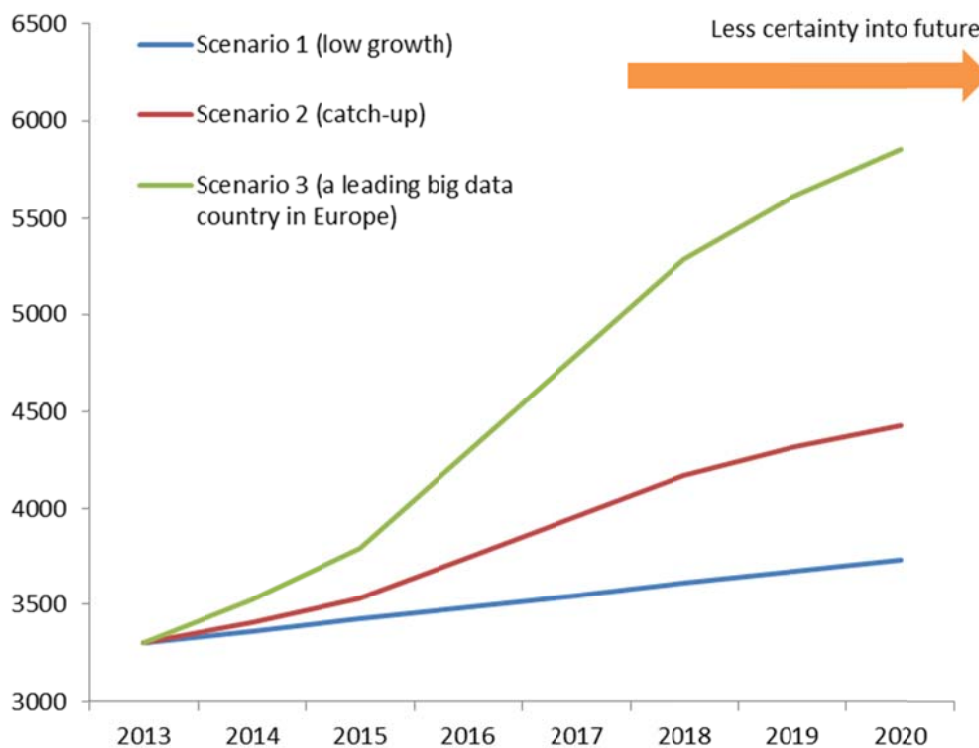


5.4 Expansion, up-skilling and replacement demand scenarios

5.4.1 Deep analytical talent expansion and up-skilling demand

Figures 5.1 and 5.2 summarise the range in deep analytical talent expansion and up-skilling demand under the three scenarios. Within Scenario 1, demand rises from 3,300 positions in 2013 to 3,734 in 2020 (+434 , 13%); to 4,427 in Scenario 2 (+1,127 , 34%); and to 5,858 in Scenario 3 (+2,558 , 78%).

Figure 5.1 Expansion and Up-Skilling Demand for Deep Analytical Talent, 2013 - 2020



Source: EY, Oxford Economics

Within the deep analytical talent category, there are two distinct types of roles (as outlined in section 3.3.3) whose demand will advance in different ways. The first of these roles, which is arguably of greater interest to this study, is the highly data-driven occupations, termed 'emerging analytics roles'. These rapidly growing roles are in areas such as customer relations management in retail and demand management in utilities, alongside a rapid growth in activities in the ICT and financial services sectors. The capacity for demand for these roles to grow rapidly in the coming years, especially in Scenarios 2 and 3, is much greater with the advent of more data availability and recognition of the benefits of such data. The second type of role, which includes occupations such as economists and actuaries, are less data-driven in the 'big' data context, and will have much more stable demand growth. As a result, future demand for more established analytical roles is assumed constant across all three scenarios.

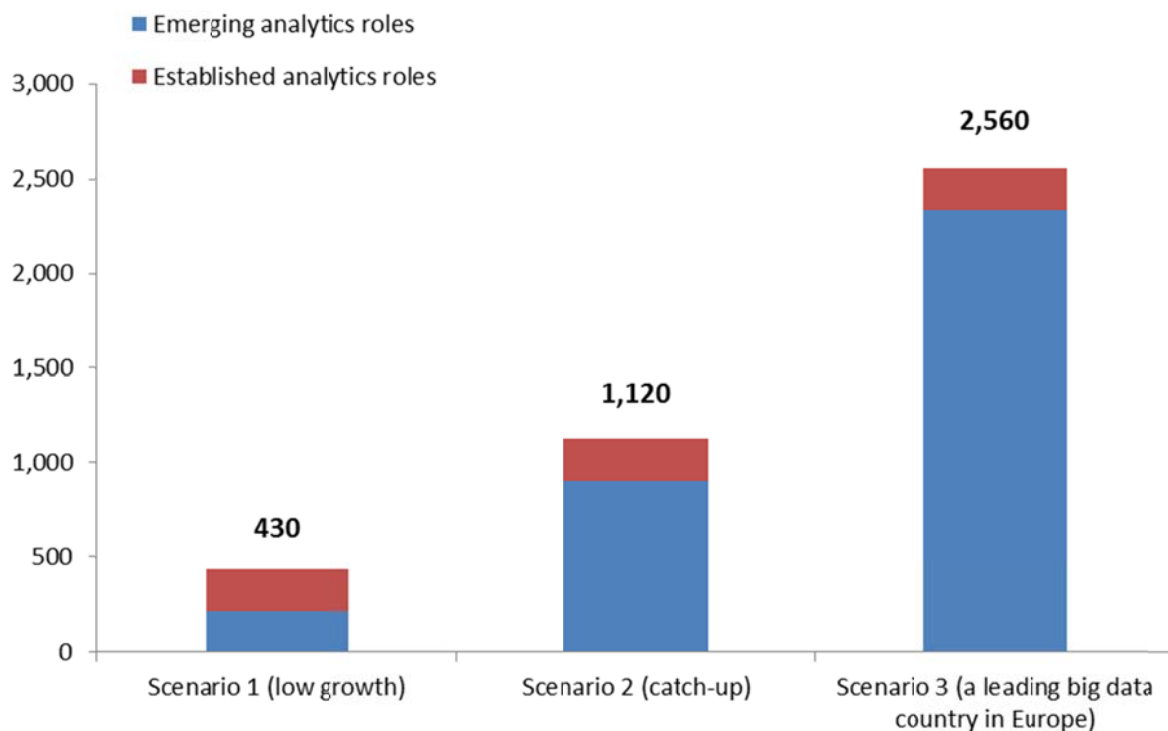
Thus it is the growth in demand for emerging analytics roles that drives the divergence in demand for deep analytical demand between the three scenarios. In Scenario 1, emerging analytical demand is only forecast to increase by 210 jobs by 2020. This compares to extra demand for emerging



analytics roles of 2,333 jobs (155%) in Scenario 3, taking total emerging analytics demand up to 3,833 jobs in 2020, from 1,500 in 2013. This would result in Ireland exceeding the point of international convergence (as defined for Scenario 2) and so becoming, in relative terms, a leading country in Europe for big data and analytics - achieving the ambition set out in the *Action Plan for Jobs, 2013*.

Assuming a similar sectoral distribution to today, the additional deep analytical talent jobs would be generated in sectors such as financial services and ICT. But for Scenarios 2 and 3, which assume wider exploitation of big data opportunities across the economy and from existing and new FDI and domestic start-up firms, the additional jobs would be spread across all sectors including the public sector, and all types of firms - small and large, and domestic and foreign-owned firms.

Figure 5.2 Expansion and Up-Skilling Demand Change for Deep Analytical Talent, 2013-2020

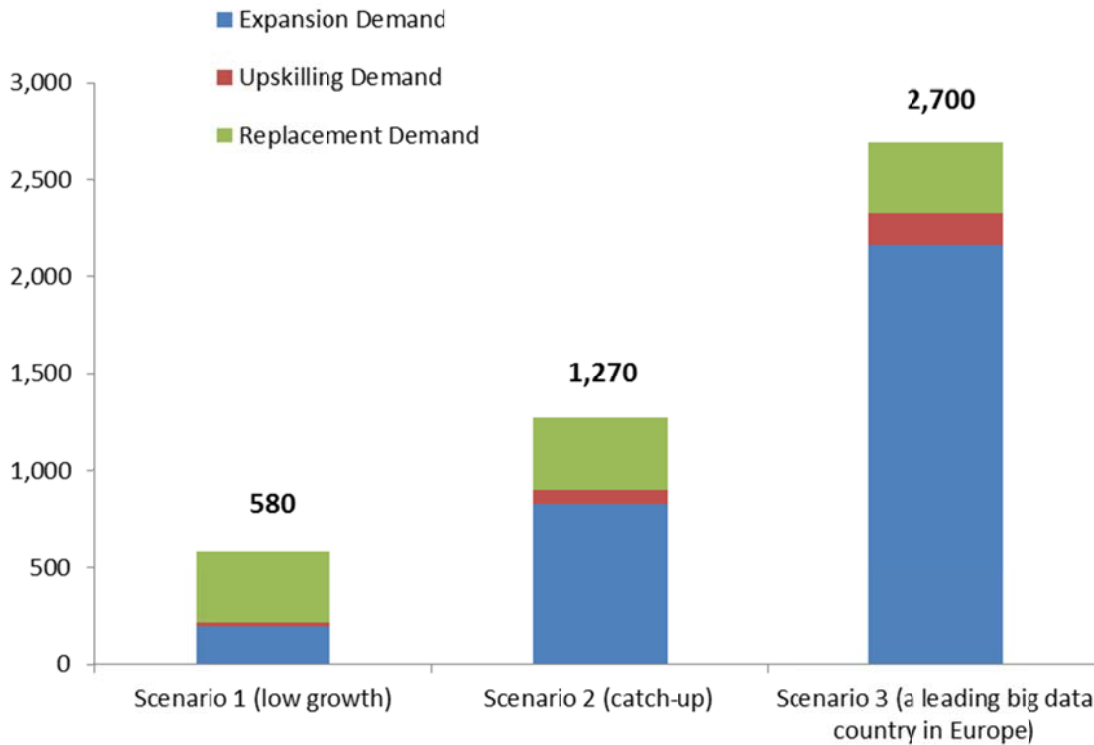


Source: EY, Oxford Economics

The majority of the growth in demand for the emerging analytics roles would be from new jobs created (expansion demand) as opposed to up-skilling. This is based on qualitative evidence gathered as part of the consultation process, on sources of new talent by role. For example the majority of new talent for deep analytics roles is assumed to come from new third level graduates or experienced hires from abroad.



Figure 5.3 Expansion, Up-Skilling and Replacement Demand for Deep Analytical Talent - “Emerging Analytics” Roles, 2013-2020



Source: EY, Oxford Economics

5.4.2 Wider big data and analytics expansion and up-skilling demand

Growth relationship between the three skill categories

In each of the three scenarios, forecast demand for each of the three skills categories grows together. From the available analysis, this is consistent with international expectations.⁵⁰ Given issues such as technological advancement, skills convergence, and the possibility of commoditisation of processes, there could be an argument for a contraction in the ratio of supporting technology professionals to deep analytical talent. However there are factors likely to exert offsetting pressure. Under a growth scenario, organisations may extend their data architecture and support models to underpin the merging of structured and unstructured data at an enterprise level. For example there could be a concurrent increase in support and specialist technical resources in addition to data governance, data security/protection and data management.

While it can be anticipated that demand across the categories will grow together, certain types of firms will have a different composition of analytics workforces. For instance, firms whose primary business is service provision in analytics can be expected to have a higher representation of deep analytical talent. By contrast, firms operating across a range of sectors will have a higher

⁵⁰ For example the e-Skills study cited earlier forecasts similar growth rates for both data specialists and data users. Within the deep analytical talent cohort, our analysis envisages that established analytical roles grow at a slower rate, for the reasons set out in Section 3.

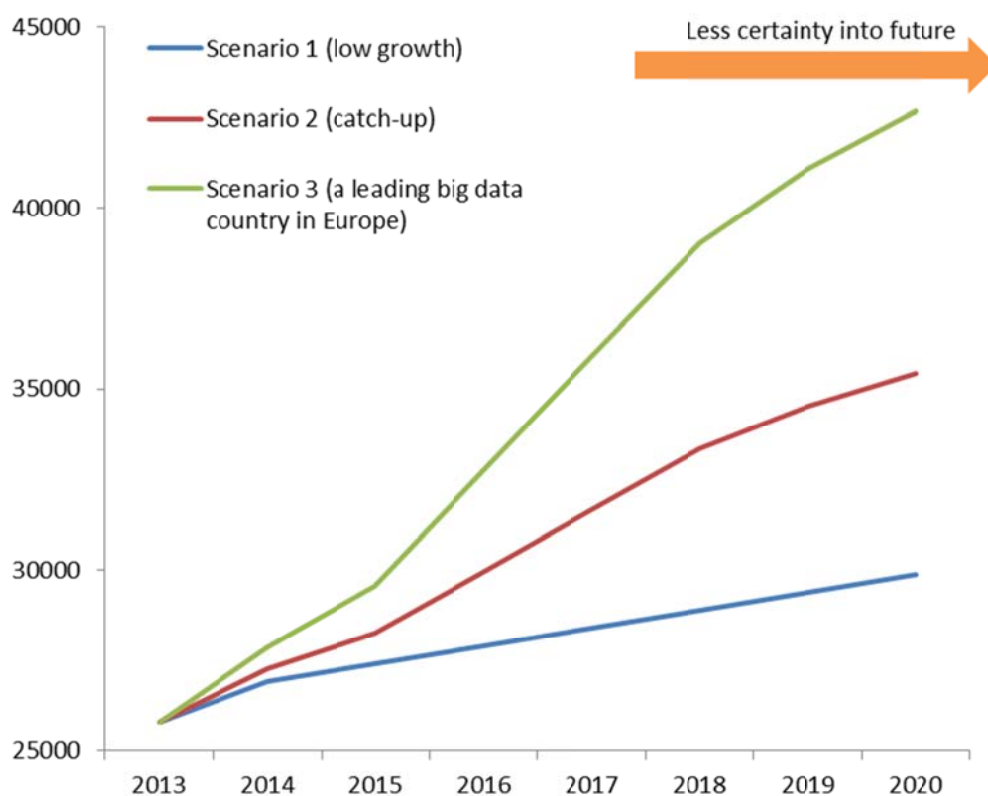


composition of data users and big data and analytics savvy roles. Given that these types of specialist service providers are likely to be targeted as new FDI, Scenario 3 therefore incorporates a slower growth rate for big data and analytics savvy roles relative to deep analytical talent for the inward investment related component of demand growth.

Big Data Savvy roles expansion and up-skilling demand

Demand for big data savvy roles rises from 25,781 positions today to 29,875 in Scenario 1 (+4,094, 16%); to 35,416 in Scenario 2 (+9,635, 37%); and to 42,695 in Scenario 3 (+16,914, 66%).

Figure 5.4 Expansion and Up-Skilling Demand for Big Data and Analytics Savvy Roles, 2013 - 2020

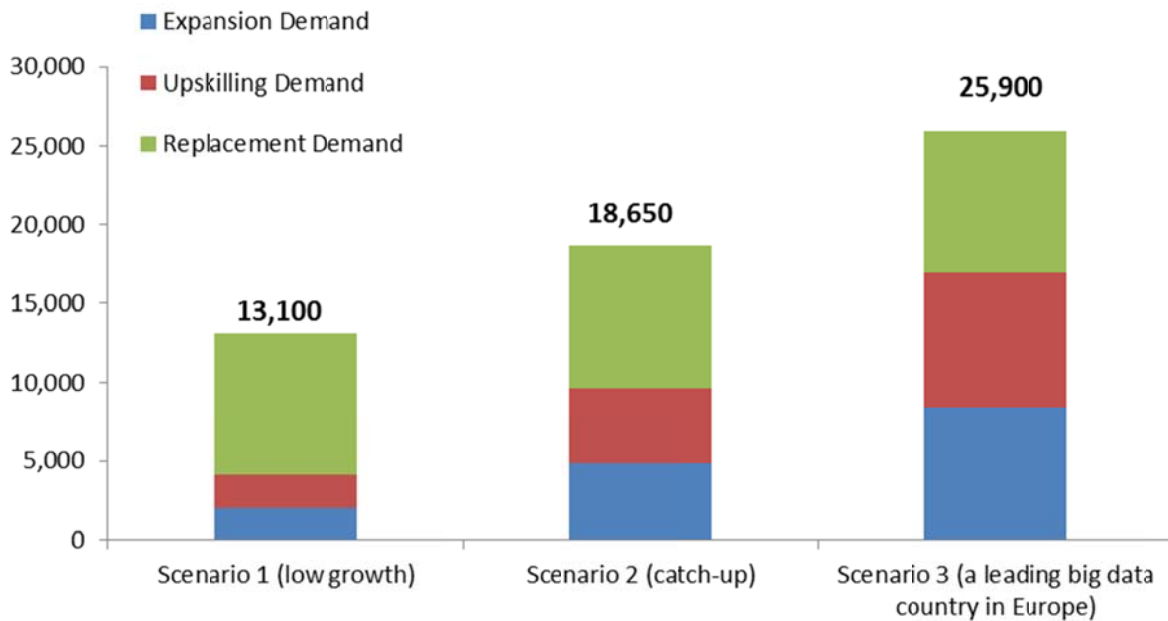


Source: EY, Oxford Economics

The growth in demand for big data savvy roles is evenly split between new jobs created (expansion demand) and up-skilling. Unlike deep analytical talent roles, according to the qualitative evidence gathered as part of consultations, a much higher share of new talent is assumed to be sourced from the re-training or up-skilling of existing staff.



Figure 5.5 Expansion, Up-Skilling and Replacement Demand for Big Data and Analytics Savvy Roles, 2013-2020

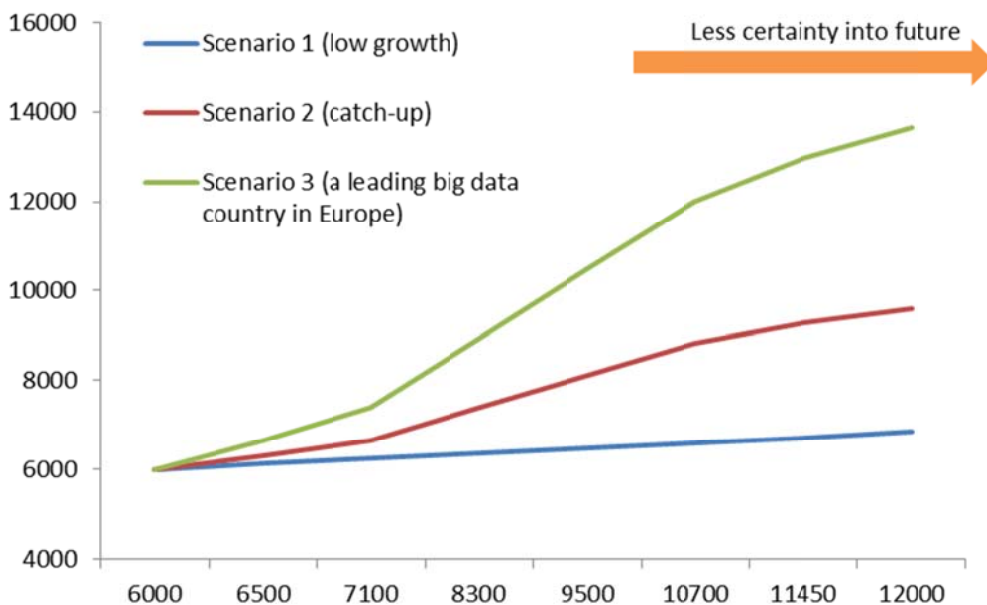


Source: EY, Oxford Economics

Supporting Technology Roles expansion and up-skilling demand

Demand for supporting technology roles rises from 6,000 positions today to 6,840 in Scenario 1 (+840, 14%); to 9,610 positions in Scenario 2 (+3,610 jobs, 60%); and to 13,667 positions in Scenario 3 (+7,667, 128%).

Figure 5.6: Expansion and Up-Skilling Demand for Supporting Technology Roles, 2013 - 2020

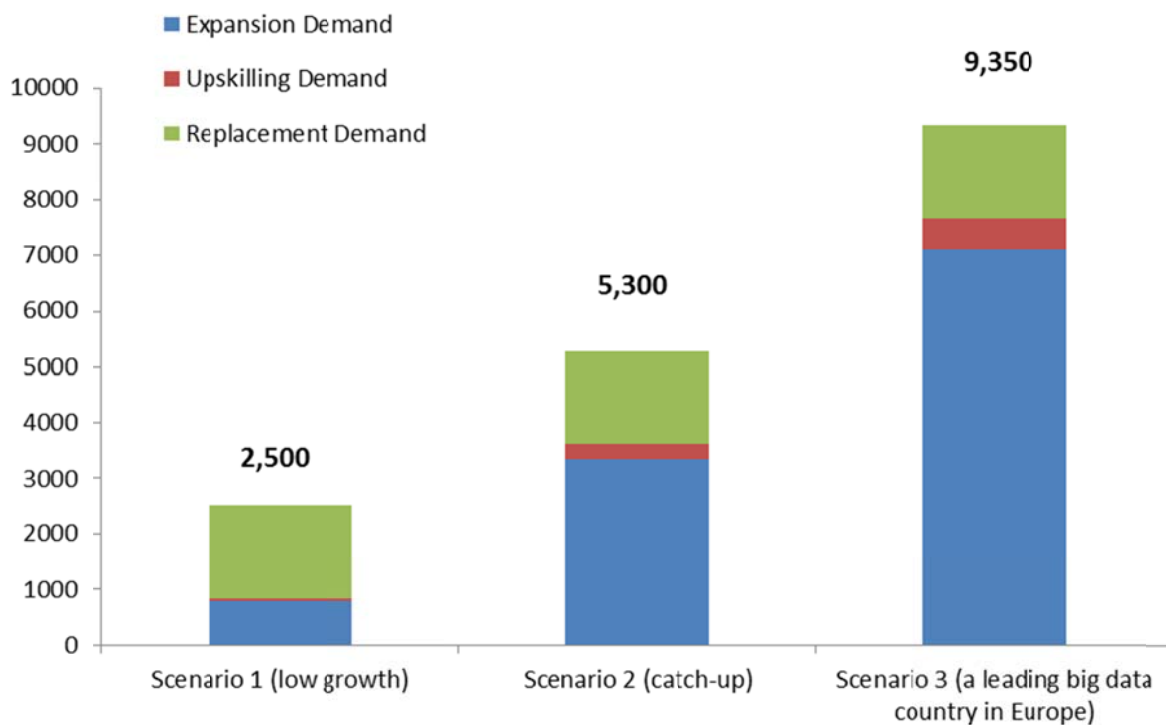


Source: EY, Oxford Economics



As in the case of deep analytical talent roles, the majority of the growth in demand for supporting technology roles is assumed to be from new jobs created (expansion demand) as opposed to up-skilling. This is consistent with the results of the survey interviews.

Figure 5.7: Expansion, Up-Skilling and Replacement Demand for Supporting Technology Roles, 2013-2020



Source: EY, Oxford Economics

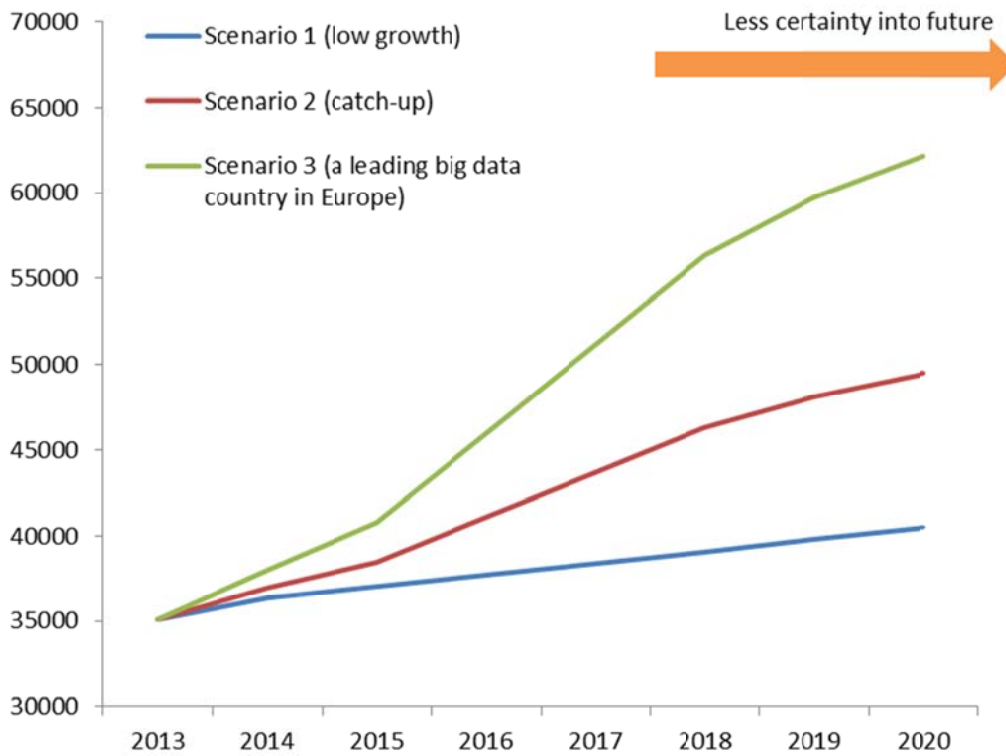
Total Big Data and Analytics roles expansion and up-skilling demand

Figure 5.8 combines the three role categories to show big data and analytics related employment under the three scenarios.

Total big data expansion and up-skilling demand rises from 35,081 positions today to 40,450 in Scenario 1 (+5,370 , 15%); to 49,453 positions in Scenario 2 (+14,370 , 41%); and to 62,220 positions in Scenario 3 (+27,140 jobs, 77%).



Figure 5.8 Total Big Data and Analytics Expansion and Up-Skilling Demand, 2013-2020

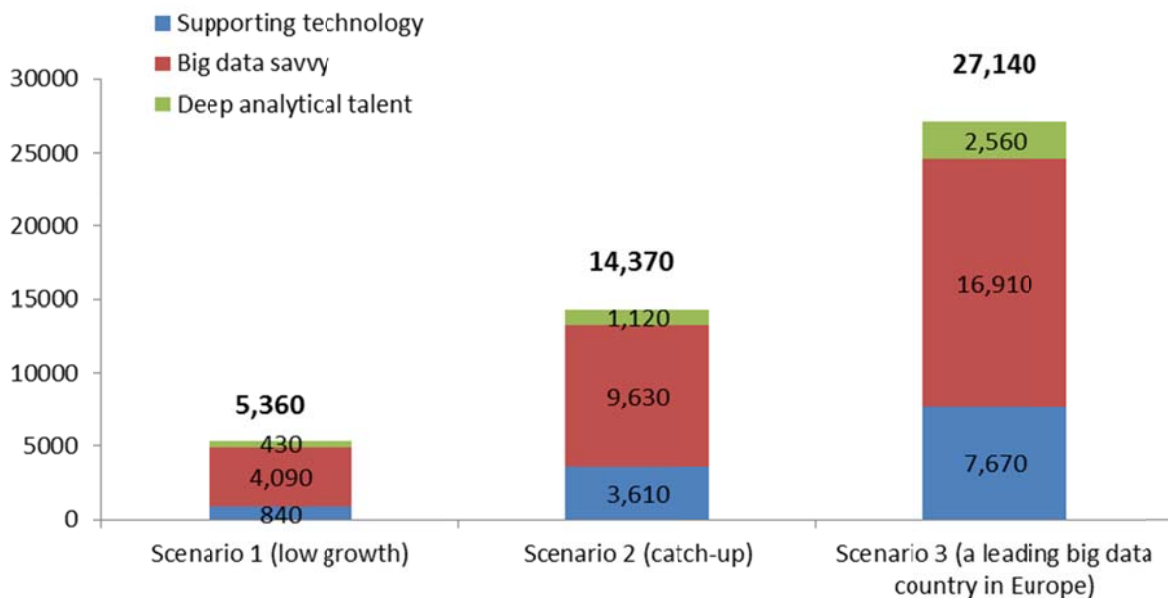


Source: EY, Oxford Economics

Across the three skill categories, the main source of additional expansion and up-skilling demand is in big data savvy roles, followed by supporting technology and then deep analytical talent. For example in Scenario 3, additional demand is in the region of 16,910 for big data savvy roles, 7,670 for supporting technology roles and 2,560 for deep analytical talent. However as explained above, half of the additional demand for big data savvy roles is for up-skilling as opposed to new roles. In contrast, the majority of deep analytical talent and supporting technology roles will be new jobs.



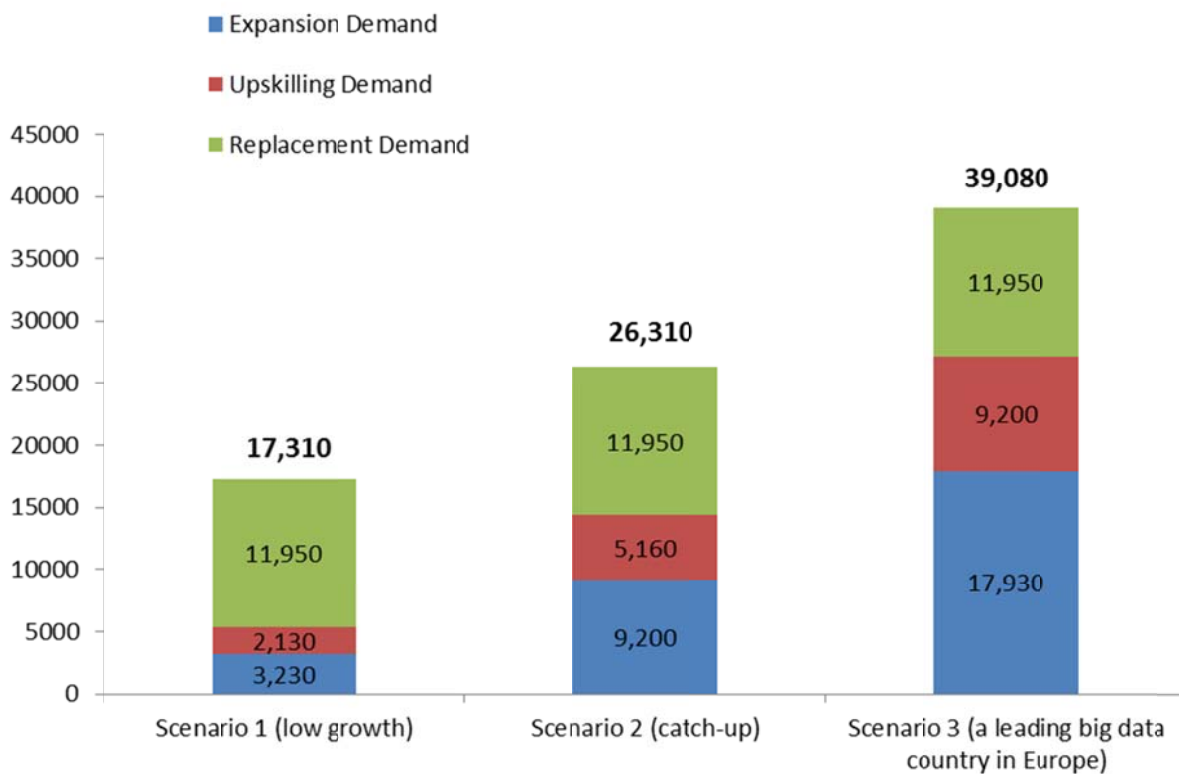
Figure 5.9 Total Big Data and Analytics Expansion and Up-Skilling Demand Change, 2013-2020



Source: EY, Oxford Economics

Figure 5.10 presents the total demand change in big data and analytics roles over the period 2013 to 2020 for each of the three scenarios.

Figure 5.10 Total Demand Change in Big Data and Analytics roles, 2013-2020



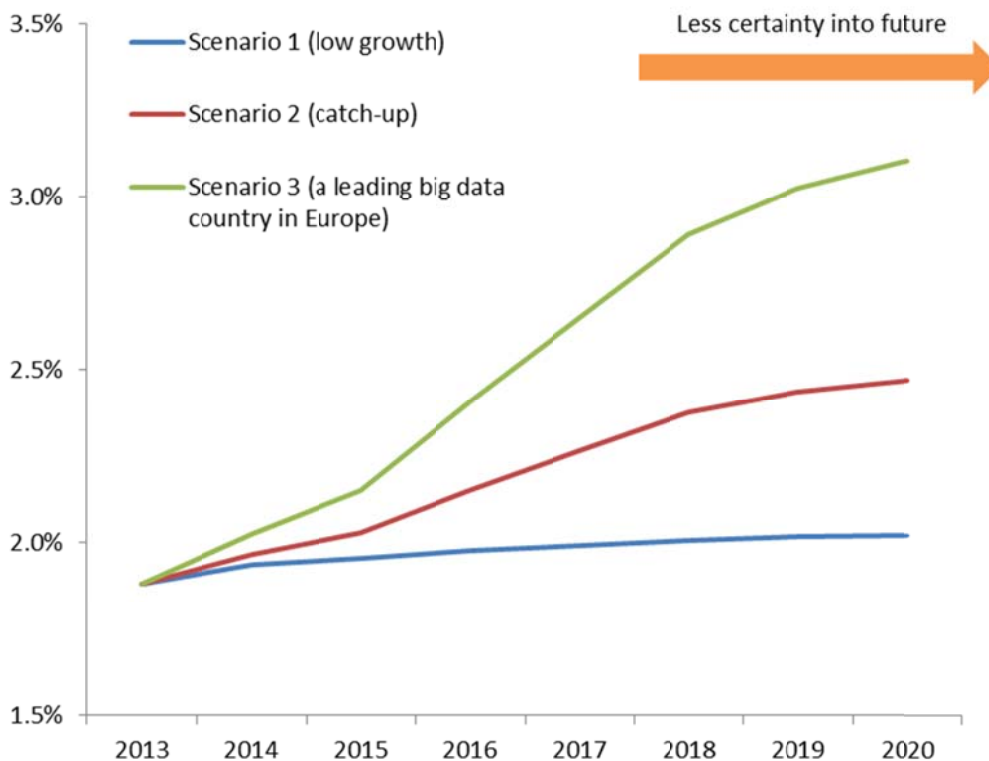
Source: EY, Oxford Economics



In all scenarios, total Big Data and Analytics talent demand is forecast to outpace total economy employment growth, and especially so in Scenarios 2 and 3. In Scenario 3, big data and analytics will increase its contribution to total economy employment from 1.9% in 2013 to 3.1% in 2020.

It must be reiterated again that big data and analytics are *activities* - rather than a discrete *sector* - for comparison we can note that in 2020, labour demand in this area would be comparable to the *administrative & support services* statistical grouping in 2013.

Figure 5.11 Big Data and Analytics Demand as a Proportion of Total Employment, 2013-2020

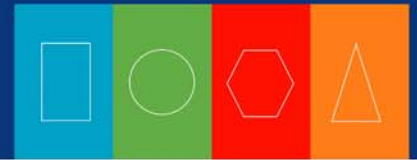


Source: EY, Oxford Economics

5.4.3 Replacement Demand

In more established and less dynamic sectors, such as low to mid-tech manufacturing, public administration and education, the majority of vacancies are a result of employees leaving or being promoted within their organisation, rather than new positions being created. For these sectors, replacement demand is a larger component of future demand than expansion demand, with the ratio typically anywhere between 5:1 and 10:1 for advanced economies. Up-skilling, the other component of future demand, is typically not quantitatively measured given it is more subjective in nature.

For big data and analytics activities, it is also important to attempt to quantify the scale of replacement demand up to 2020 in order to present a holistic picture of talent demand and the vacancies that will need to be filled with new supply. Unlike the established sectors described above, big data and analytics differs in a number of ways. It is more nascent and has a relatively younger employee base, so the rate of turnover to retirement is likely to be modest. For example



the average age profile of roles, based on company consultations, ranges from 28 for supporting technology to 38 for big data and analytics savvy roles. This implies that the ratio of replacement to expansion demand will be much lower in this area over the period under consideration for the higher employment growth Scenarios 2 and 3. While the early stage and age profile of the sector mean that attrition tends to be lower, offsetting this may be an element of out-migration of analytics talent to other countries given the global skill shortages in this area.

At an individual firm level, the loss of talent to other firms comprises an element of their replacement demand. At a broader big data activity level, this is less of an issue as the churn of staff across big data activities within the economy has a zero net effect on replacement demand (however, if big data staff are, say, lured from ICT to financial services then this will create a talent problem for ICT big data activities). There is also a perception, identified in the consultations, of large, multinationals being able to attract talent from other firms, by outcompeting them in terms of salary, perks and their brand appeal. This issue can be over-played, and may be viewed as a natural outcome of a competitive labour market which can help to 'raise the bar. However, it also an indication of the need for an adequate data analytic skills supply to help drive the transformation in data intensity required throughout the wider economy.

Gross replacement demand rates are difficult to estimate precisely. As part of the consultation phase for this study, organisations were asked about how concerned they are about staff attrition and the average staff attrition rates as a share of existing employment levels. Although a majority of respondents are not currently concerned about attrition - suggesting current levels of attrition are relatively low - a large number expect this to become an issue in the coming years as demand increases.

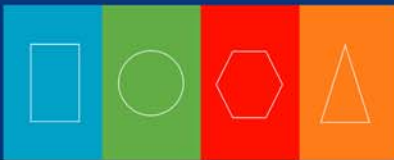
The assumed annual gross replacement demand rates are as follows:

- Deep analytics roles - emerging analytics - 3.5%
- Deep analytics roles - established analytical - 6.5% owing to older age structure in these roles
- Big data savvy - 5%
- Supporting technology - 4%

A higher replacement demand rate (5%) is assumed for big data and analytics savvy roles given the older age structure compared to supporting technology roles (4%). The supporting technology replacement demand rate is consistent with the recent EGFSN study *Addressing Future Demand for High-Level ICT Skills in Ireland*. Emerging analytics roles have the lowest replacement demand rate given the relative nascence of the activities and roles.

The replacement rates used here are estimated based on information available for similar occupational categories, information on the age profile of the analytics workforce as ascertained during the consultation and other qualitative insights such as firms' experiences and views in relation to attrition within the analytics workforce. It will be important to monitor actual replacement demand rates over time.

The results of the replacement demand forecasts projections are presented in Table 5.3 alongside expansion demand and up-skilling projections, for each scenario. Figures 5.4, 5.6, 5.8 and 5.11 above also presented replacement demand projections.



As expected, the relative balance between expansion, up-skilling and replacement demand varies by scenario, with expansion demand the much more important component of demand for Scenario 3. Replacement demand makes up 70% of total demand for Scenario 1 but only 30% for Scenario 3.

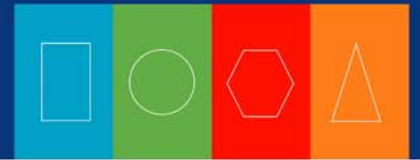
Table 5.3 Summary of Future Demand Change Projections, 2013 - 2020

	Scenario 1 (low growth)	Scenario 2 (delayed catch-up)	Scenario 3 (a leading country in Europe)
Expansion demand	3,230	9,200	17,930
Deep analytical talent	410	1,050	2,380
<i>of which emerging analytics roles</i>	<i>190</i>	<i>830</i>	<i>2,160</i>
<i>of which established analytical roles</i>	<i>220</i>	<i>220</i>	<i>220</i>
Big data savvy	2,040	4,810	8,450
Supporting technology	780	3,340	7,100
Upkilling demand	2,130	5,160	9,200
Deep analytical talent	20	70	170
Big data savvy	2,050	4,820	8,460
Supporting technology	60	270	570
Replacement demand	11,950	11,950	11,950
Deep analytical talent	1,250	1,250	1,250
<i>of which emerging analytics roles</i>	<i>370</i>	<i>370</i>	<i>370</i>
<i>of which established analytical roles</i>	<i>880</i>	<i>880</i>	<i>880</i>
Big data savvy	9,020	9,020	9,020
Supporting technology	1,680	1,680	1,680
Total demand	17,310	26,310	39,080
Deep analytical talent	1,680	2,370	3,800
<i>of which emerging analytics roles</i>	<i>580</i>	<i>1,270</i>	<i>2,700</i>
<i>of which established analytical roles</i>	<i>1,100</i>	<i>1,100</i>	<i>1,100</i>
Big data savvy	13,110	18,650	25,930
Supporting technology	2,520	5,290	9,350

Source: EY, Oxford Economics

5.4.4 Scenario risks

As identified in Table 5.2, there are a number of drivers and assumed interventions / supporting conditions underpinning each scenario. Accordingly there are risks associated with each scenario. Globally, there is a risk of diminishing marginal returns and collection of an excess volume of data, reducing the business case for big data and analytics investment with knock-on impacts to big data and analytics employment. With big data today said to be at, or about, the peak of expectation of the 'hype cycle' regarding the potential value that can be extracted, recent rapid growth may not be sustained going forward. This has specific risks for Scenario 3 where Ireland would become an international leader and exports big data and analytics services in an assumed fast growing global big data environment.



Domestically, high wage costs for deep analytical talent, a key factor in international competitiveness, could encourage outsourcing rather than attract new FDI and grow big data roles amongst existing firms. However, high wages, where they reflect high productivity, are much less of a barrier to expanding value added deep analytics roles.

There is also a risk that Irish firms could be burdened by high investment and data storage costs. Insufficient scale and technical capacity may also limit small to medium-sized firms' foray into big data and analytics. Organisations may also fail to recognise the benefits of big data and analytics and thus not factor this into corporate planning and activities. A number of other factors could also constrain domestic growth of big data: Ireland's more limited public availability of data; exacting EU legislation and domestic data protection arrangements; and the public service employment ceiling, which acts as a barrier to potential big data and analytics related employment in Government Departments and Agencies.

While it is likely that in practice the supply of big data and analytics talent would act as the most limiting constraint on the achievement of some of the targets set out, the process of scenario development excludes potential supply constraint issues. This is so that all potential demand side factors can be understood and set out as an input to the policy response in relation to supply.

5.4.5 Alternative employment growth pathways for emerging deep analytical talent

Each of the three scenarios assume a relative steady growth in demand, notwithstanding a pick-up in growth later in the period up to 2020 and variation in growth across the scenarios.

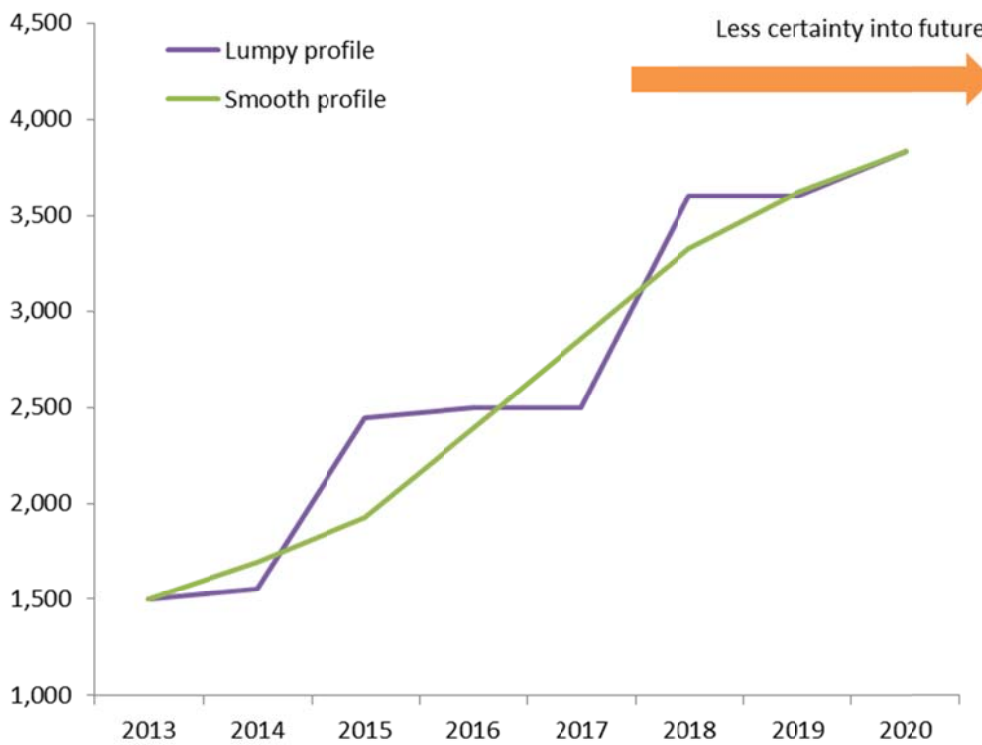
In reality, given the current small size of the big data and analytics business area, the demand trajectory is likely to be much 'lumpier'. For example there could be large gaps in timing between new big data and analytics expansions, and more than one expansion may occur at the same time and in the same location.

Figure 5.12 presents two alternative pathways for emerging deep analytical talent employment in Scenario 3 - a relatively smooth growth pathway, as presented above, versus a 'lumpier' profile - but with both scenarios still reaching the same employment level by 2020. The implication is that there needs to be flexibility and responsiveness in the supply of big data and analytics talent to meet unpredictable demand. This is not unique to the big data and analytics sector but its small current size means that demand from one new FDI project, or major domestic expansion, could represent a sizable proportion of the business area's overall demand.

In order to convince existing organisations based in Ireland and new inward investors that Ireland is able to meet talent demand, whilst ensuring competitive wage levels, and avoiding displacement of talent from existing firms, it is important that talent supply is not only flexible but perhaps also available in advance of potential future demand. The latter point has implications for the timing of increasing big data graduate outputs, bringing forward any necessary changes in the employment permit system and the timing of up-skilling existing big data savvy roles.



Figure 5.12 Demand for Emerging Deep Analytical Talent, 2013 - 2020 (Scenario 3)



Source: EY, Oxford Economics

5.4.6 Likelihood of scenarios

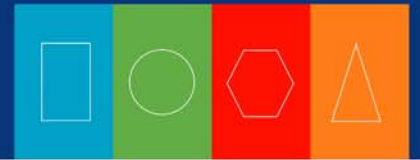
It is common when presenting scenarios to be asked the likelihood of each scenario and which is most likely. The three scenarios depend on a range of global and domestic factors and decisions to be taken by government and private firms.

Given the nascence of big data and analytics activities in Ireland and the extent of both growth opportunities and challenges, the scenarios are more a depiction of what could happen rather than what will happen with certainty.

Scenario 1 assumes no further policy action or specific measures aimed at increasing the level of adoption of big data and analytics across the economy. In practice, the Government has announced a range of steps to drive this area which would mean that this scenario underestimates what might happen, and so the prospect of the outturn in Scenario 1 materialising is considered low.

Given the weight of policy focus afforded in this area, investment in major research infrastructure and recent announcements in relation to Open Government, it is considered far more likely that Ireland will converge with international comparators with regard to the level of adoption of big data and analytics. For this reason, Scenario 2 is considered far more likely than Scenario 1.

Into the medium-term and consistent with the Government's *Action Plan for Jobs 2013*, policy should aim to drive Ireland beyond convergence and strive to become a leading country in Europe for big data and analytics and achieve the scale of the ambition set out in Scenario 3.



6. Big Data and Analytics skills supply

6.1 Overview

Having assessed likely future demand scenarios for big data and analytics talent, it is necessary to turn attention to the supply side in order to assess whether sufficient skills will be available into the medium-term.

This section begins with an overview of global trends in big data and analytics observed and forecast internationally. Available information on domestic supply trends is also cited.

As an input to this project, a review of existing and planned domestic provision at National Framework of Qualifications (NFQ) levels 6-10 was carried out. The high level findings of this analysis are set out in this Section.

6.2 Supply of Big Data and Analytics talent - findings from the literature

The four international studies cited in relation to baseline employment are again used in setting the backdrop for our analysis of skills supply.

MGI analysis models the supply of undergraduate and postgraduate degree courses that feature deep analytical training (including statistics and machine learning).⁵¹ Analysis of US education data is used to calculate the ratios of total graduates across a range of disciplines that have advanced quantitative training. These ratios are applied to other countries to assess global supply. The disciplines reviewed were:

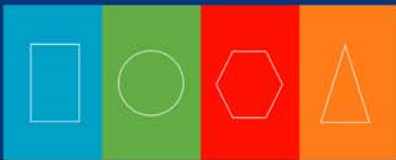
- Computer and information sciences;
- Mathematics and statistics;
- Engineering;
- Physical sciences and science technology;
- Biological and biomedical sciences;
- Social sciences; and
- Business.

The analysis finds that supply of the deep analytical talent cohort in the US in 2008 was of the order of 150,000 positions. Based on trends in the numbers of new graduates with deep analytical training and patterns in migration, this is set to increase to 300,000 by 2018. While this is a substantial increase, overlaying growth in demand forecast over the period shows very significant talent shortages of between 45-60 per cent.

The analysis posits that talent shortages will be a global phenomenon. There will be significant variations in both total and per capita production of big data and analytics talent. This could lead to countries targeting the importation of talent through migration or prompt outsourcing of functions to geographies where skills are in more abundant supply.

In relation to the big data savvy cohort, MGI note that the level of training and mathematical aptitude required is much lower than for deep analytic roles and these skills can be developed through a single course in statistics or experimental design. While supply can be addressed more

⁵¹ MGI (2011) Op. cit.



readily than in the case of the deep analytical talent cohort, demand will be on a far larger scale. The analysis forecasts growth in supply to 2.5 million positions in 2018 with demand as high as four million positions, a shortfall of almost 40%.

Further research shows that the number of graduates holding advanced degrees in highly quantitative disciplines has significantly increased in high growth countries (and is expected to continue this trajectory over the medium-term) but has slowed in more mature economies.⁵² For example China and India are out-producing mature economies in total and are also growing the share of graduates with skills required for analytics jobs.

At the same time the international analysis suggests some concern in relation to the quality of training and qualifications in these high growth economies, so that formal qualifications do not guarantee adequate skills. Added to this, the primary language of international business continues to be English and this further constrains the employability of graduates in some locations. Adjusting for these types of issues, leads to the conclusion that just 6% of all graduates can be considered potential analytics talent.

An important point set out in the international analysis which has relevance for the present study is that because many jobs utilise the same skills, there is competition for talent from other occupations and therefore only a small percentage of a country's potential analytics talent end up in analytics jobs. The report cites insight from talent management experts indicating that between 10 and 20% of potential analytics talent actually takes up analytics jobs. The remainder goes into a range of roles from investment banking to academia.

The baseline scenario set out in the Accenture analysis is that 15% of available relevant talent chooses analytics careers. This however will lead to a global shortfall of almost 30%. The shortfall will be more acute in particular role categories however; the data scientist group is forecast to experience a global talent deficit of some 60%.

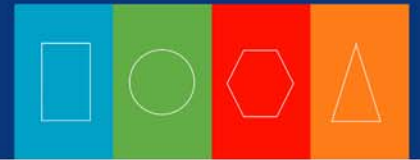
The available analysis for Ireland was undertaken by the UK Council for Economics and Business Research (Cebr).⁵³ On the supply side, the analysis took a similar approach and set out the wide range of disciplines from which deep analytical talent could be drawn. These were:

- Combined science maths and computing;
- Combined maths and statistics;
- Maths;
- Statistics;
- Computer science; and
- Computer use.

Because of the breadth of the potential talent pool and the fact that the wide skills base will also go into other fields, it is not appropriate to transpose supply directly onto demand. The approach by Cebr to understanding the interaction of supply and demand was to set out the ratio of relevant graduates who would be required to choose analytics careers in order to satisfy demand. The study showed that this is about 17%.

⁵² Accenture Institute for High Performance (2013) Op. cit.

⁵³ Cebr (2013) Op. cit.



6.3 Skills Supply in Ireland

The supply of big data and analytics dedicated third level courses within Ireland is at an early stage, mainly due to the fact that the demand for such talent is still emerging. This section looks at current and planned course provision for data analytics and related skills in Ireland at NFQ levels 6/7 and 8/9/10. The analysis includes, where available, the total numbers enrolled for the 2011/2012 period and also most recent graduate output, in most cases for 2011 (the most recent year most data is available from the Higher Education Authority). For the purposes of assessing skills supply, dedicated analytics courses along with programmes in complementary disciplines are considered. These courses are of most relevance to the deep analytical talent cohort and are:

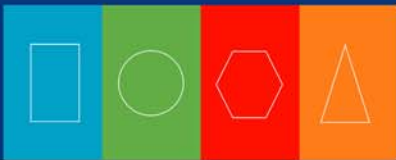
- Dedicated big data & analytics programmes;
- Programmes that include significant training/elements in data analytics;
- Maths, statistics and science;
- Computer science programmes;
- Engineering programmes;
- Physics programmes;
- Data analytics programmes in Northern Ireland;
- Private data analytics programmes; and
- Online education in data analytics.

These disciplines are consistent with the sources of deep analytical talent identified during the consultation phase for this project.

In addition, it is important not to lose sight of the need for talent in the other role categories. For the supporting technology group, supply and demand will be a subset of the broader ICT professional talent pool and is encompassed in the Addressing Future Demand for High Level ICT Skills study undertaken by Forfás/EGFSN.

For the big data and analytics savvy group, up-skilling by industry will be the primary source of skills in the short-term. Added to this, a large number of third level courses at all levels involve foundation and intermediate level training in statistics and data analytics. While some courses teach more traditional statistical learning, others have built upon this foundation to develop modules in applied analytics in a business setting (see Box 6.1). While a detailed audit of these has not been prepared, there is likely to be sufficient output from such courses to satisfy the portion of demand for big data and analytics savvy roles required to be met by new graduates.⁵⁴ In the future, such applied analytics courses could be made more widely available.

⁵⁴ Approximately 11% of responses to the company consultation highlighted new third level graduates as a source of future employees in the big data and analytics savvy category.



Box 6.1 Analytics in UCD's Bachelor of Commerce

Modules in data analytics are a core component of the Bachelor of Commerce curriculum in first and second years and there is an optional specialisation for final year students.

- In 1st Year *Data Analysis for Decision Makers* is mandatory. Taking an approach based on practical application to business problems, this module provides students with the basic skills required to calculate, analyse and present useful statistical measurements from large-scale data sets; create and interpret inferential statistical statements and interpret the results of data analyses with a view to informing decision making.
- In 2nd Year, *Business Analytics* is a core course. This module introduces and formulates mathematical models for business applications such as resource allocation, employee assignment, investment, customer churn, and product mix. Emphasis is placed not only on formulating and using models to obtain optimal solutions, but on understanding case study problems, choosing the appropriate models, and interpreting and critiquing the results. Both manual and software-based solution procedures are used, with software tools used particularly for mathematical programming applications.
- In final year, students have the option to undertake the more advanced module *Analytics Modelling*.

6.3.1 Dedicated big data and analytics programmes

There are currently 15 dedicated data analytics courses in Ireland with an enrolment of approximately 500 students. Four further programmes are planned for a 2014 or 2015 start. These programmes are predominantly at Level 8 and Masters Level/ NFO level 9. As most of these programmes have only recently been set up, just four recorded graduate numbers in 2011.

Table 6.1 provides summary details in relation to these programmes. A commentary on these is provided in Appendix 3.



Table 6.1 Specialist Data Analytics Programmes

Course Title	Provider	NFQ Level	Enrolment Numbers
BA in Management Science & Information Systems Studies	TCD	8	126 (21 graduated in 2011)
MSc in Computing (Data Analytics)	DIT	9	30
Diploma leading to MSc in Data Business	IMI in conjunction with UCC	8/9	23
Higher Diploma in Science in Data Science & Analytics	Cork IT	8	20
Higher Diploma in Science in Data Analytics	NCI	8	56
MSc in Computing (Business Intelligence & Data Mining)	IT Blanchardstown	9	35
Professional Diploma in Data Analytics (online)	UCD	9	62
MSc in Business Analytics Full-Time	UCD Smurfit Graduate Business School	9	31 (23 graduated in 2011)
MSc in Business Analytics (conversion) Part-Time	UCD Smurfit Graduate Business School	9	18
MSc Data Science & Analytics	UCC	9	9
CPD Diploma in Financial Mathematics & Analytics	DIT	8	5
MSc in Computing in Data Analytics	IBM/DCU	9	9 part-time
ME Computer Science & Information Technology (Specialism in Big Data & Analytics)	NUI Galway	9	Commencing 2014/2015
BSc in Business Analytics	UCD	8	Commencing 2015/2016
MSc in Business Analytics	NUI Galway	9	Commencing 2015/2016
Total Numbers enrolled Mainstream			424
Certificate in Programming for Data Analytics (Springboard)	IT Blanchardstown (30 credits)	6	35
Certificate in Social Media and Web Analytics (Springboard)	IT Tralee (30 credits)	7	8 (38 graduated in 2013)
Diploma in Business Analytics (Springboard)	NUI Galway (30 credits)	8	15
Higher Diploma in Science in Data Analytics (Springboard Programme)	NCI	8	100
Total numbers enrolled Springboard			158 enrolments
Total Number enrolled Mainstream and Springboard			582 enrolments

Source: Forfás, 2014

6.3.2 Programmes with a significant data analytics component

There are currently eighteen programmes (with 760 students enrolled) which have significant streams or electives in data analytics. These are on both undergraduate and postgraduate degrees in computing, cloud computing, business information systems and other areas where students have a choice of related modules or electives.

Table 6.2 Programmes which Include Specialisations/Modules in Data Analytics

Course Title	Provider (<i>and relevant module</i>)	NFQ Level	Total Numbers Enrolled (year)	Graduate Numbers
BSc in Computing in Applications & Support	DKIT (Data Analysis for Computing)	7	14 (2013/2014)	90 (2005-2012)
BSc in Computing in Networking & Support	DKIT (Data Analysis for Computing)	7	15 (2013/2014)	67 (2005-2012)
BSc in Computing in Software Development	DKIT (Data Analysis for Computing)	7	20 (2013/2014)	163 (2005-2012)
BSc (Hons) in Business Information Systems	NCI (Data Structures, Algorithms, Business Data Analysis, Artificial Intelligence)	8	83 (2011/2012)	20 (2011-2012)
BSc in Computational Problem-Solving and Software Development	DCU (Data Structures and Algorithms)	8	8	New course for 2013
BSc in Enterprise Computing	DCU	8	211 (2011/2012)	-
BSc in Computer Applications	DCU (Advanced Algorithms and Data Structures)	8	149 (2011/2012)	-
BSc in Computer Science & Information Technology	NUIG (Modern Information Management, Machine Learning & Data Mining)	8	50 (2013/14)	-
BA in Information Systems Management	GMIT	8	25 (2013/14)	-
H Dip Computing	DIT (Specialisation in Big Data)	8	50 (2013/14)	-
MSc Cloud Computing	NCI (Data Storage & Management)	9	N/A	N/A



MSc in Cloud Computing	Cork IT (Data Analytics)	9	62 (2011/2012)	Established 2011
MSc in Computer Science - Negotiated Learning	UCD (Machine learning, Network Data Analysis, Data Mining techniques & models, numerical algorithms)	9	24 (2011/2012)	17 (2011)
MSc Cloud Computing Research	NUIG	9	8 part-time	
MSc in Computing (Information & Knowledge Management)	DIT (Programming for Big Data)	9	21 (2011/2012)	0 (2011)
MSc in Computing (Knowledge Management)	DIT	9	16 (2011/2012)	14 (2011)
MSc in Computing (Advanced Software Development)	DIT (Programming for Big Data)	9	23 (2011/2012)	-
MSc in Global Financial Information Systems	WIT (Data Modelling and analysis, Business Intelligence and Data Warehousing)	9	22	-
Total			760 enrolments	

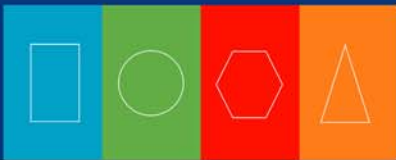
Source: Forfás, 2014

PhD supply

The Insight Centre for Data Analytics is a joint initiative between researchers at UCC, UCD, NUI Galway, DCU and other partner institutes including Trinity College Dublin, NUI Maynooth, Royal Irish Academy and the Tyndall National Institute. It was established in 2013 by Science Foundation Ireland funding of €75m. The centre will bring together a critical mass of more than 200 researchers from Ireland's leading ICT centres to develop a new generation of data analytics technologies in a number of key application areas. The research agenda is divided into two key strands and is delivered by working with a wide range of industry partners. The domains are:

- Connected Health - consisting of strands in chronic disease management and rehabilitation; novel personal sensing; and connecting health and life sciences
- The Discovery Economy - consisting of strands in smart technologies, future news and media; the analytical society; and discovery analytics

Over the period 2015 to 2019 the supply of high-level data analytic talent will be augmented by a planned output of 125 MSc graduates and 125 PhD graduates (with the PhD graduates output weighted towards the back-end of the period). There is a strong focus on industry relevance and readiness and a target is in place to have industry as the first destination upon graduation for some 50% of graduates.



6.3.3 Complementary disciplines

The following more general programmes impart the deep-analytical, problem-solving and quantitative skills needed for data analytics roles:⁵⁵ Graduates from these general STEM categories are very well placed to up-skill for the data analytics roles.

- Combined mathematics and statistics (ISCED 460);
- General mathematics (ISCED Code 461);and
- Statistics programmes (ISCED Code 462).
- Combined science, maths and computing programmes (ISCED Code 400)

The general Mathematics ISCED category (461) includes degrees in Applicable/Applied Mathematics, Arts degrees majoring in Maths, Research Masters in Maths, Financial Mathematics and Actuarial Science and also Mathematical Modelling. The Combined Mathematics and Statistics category, (ISCED 460), includes programmes in Actuarial Applications, Mathematical Studies, and joint Economics and Mathematical Sciences degrees. The Statistics category (462) mainly covers programmes in Maths and Statistics, Actuarial and Financial Studies, Applied Statistics, Actuarial Mathematics and general Higher Diplomas, Bachelors and Masters Degrees in Statistics. Finally, the Combined Science, Mathematics and Computing category (400) comprises general science bachelors and Master’s degrees, some with a specific focus on Financial Maths and Economics, Arts degrees with a focus on Science, Maths and Computing and Mathematical Sciences degrees. In 2013, there were 1,600 students enrolled on these courses. 540 students graduated in 2011.

International literature and the findings of the consultations for this study agree that engineering disciplines are potentially very suitable sources of talent for analytics roles given the focus on problem-solving and high level of quantitative ability. Table 6.3 presents engineering disciplines (ISCED 52) and provides undergraduate and postgraduate output for 2011. ISCED categories include combined engineering and engineering trades; mechanics and metal work; electricity and energy; electronics and automation; chemical and process; and motor vehicles, ships and aircraft. Graduates with engineering backgrounds have an aptitude for applied problem solving and machine learning which is essential for analytics roles. Therefore, these cohorts of graduates are well suited to up-skill or retrain for careers in data analytics.

Table 6.3 Engineering – Graduates 2011 (ISCED 52)

Undergraduate Cert/Diploma	Level 7 (Ordinary Degree)	Level 8	Postgraduate Cert/Diploma	Level 9 Masters Taught/Research	Level 10	Total
311/0	1,159	1,236	6/62	400	152	3326

Source: HEA Key Facts and Figures 2013

Physics graduates (ISCED 441) have been identified as a potential supply pool from which analytics talent could be drawn.⁵⁶ Physicists possess the quantitative and deep analytical skills necessary for

⁵⁵ Enrolment and Graduate figures for programmes such as the BSc Common Entry into Science, Bachelor of Science (Undenominated) and Natural Sciences in ISCED 400 (Combined Science and Mathematics) have not been included.

⁵⁶ Accenture Institute for High Performance (2013) Op. cit.



data analytics roles. Table 6.4 presents the 2011 undergraduate and postgraduate numbers from all physics programmes.

Table 6.4 Physics Graduates 2011 (ISCED 441)

Undergraduate Cert/Diploma	Level 7 (Ordinary Degree)	Level 8	Postgraduate Cert/Diploma	Level 9 Masters Taught/Research	Level 10	Total
10	33	121	4	22	68	258

Source: HEA Key Facts and Figures 2013

6.3.4 Data analytics programmes in Northern Ireland

Given the high degree of labour mobility across the border, courses available in Northern Ireland will also augment the supply of skills available in Ireland. There is an MSc in Computational Intelligence available at the University of Ulster, Magee which offers modules relevant to the data analytics area. Computational Intelligence (CI) is a domain of artificial intelligence in which the emphasis is placed on heuristic algorithms and evolutionary computation. The course focuses on providing a core foundation in computational intelligence, and aims to impart students with the high-level skills necessary to develop a career in computing / engineering, or pursue further research in computational intelligence.⁵⁷

6.3.5 Private data analytics courses

There are approximately eleven private training courses which provide training in data analytics, statistics and related skills. These are suitable for professionals or managers wishing to gain an insight into data analytics and its uses in business. The majority of these courses are under a week in duration with many of them being run by the Analytics Store. Table 6.5 presents further detail.

⁵⁷ <http://study.ulster.ac.uk/prospectus/course/201415/2839>

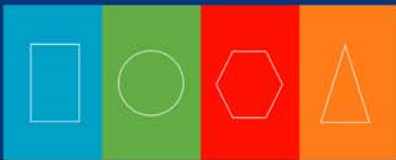


Table 6.5 Private sector Data Analytics Courses

Course Title	Provider	Duration
Business Statistics	New Horizons in partnership with The Analytics Store	2 Days
The Art of Building Data Mining Models	New Horizons in partnership with The Analytics Store	3 Days
Understanding Statistics for Managers	New Horizons in partnership with The Analytics Store	1 Day
Putting the Data into Predictive Analytics	New Horizons in partnership with The Analytics Store	3 Days
The Art and Craft of Advanced Analytics	New Horizons in partnership with The Analytics Store	3 Days
Analytics for Marketing	New Horizons in partnership with The Analytics Store	1 Day
Data Visualisation	New Horizons in partnership with The Analytics Store	2 Days
BI Enterprise Data Warehousing	Olas	5 Days
Data Analysis and Design	C2 Cork	2 Days
Analysing Data	The Open University	
Advanced Data Warehousing	Guru Team	3 Days

Source: Forfás, 2014

6.3.6 Skillnet short courses planned in the big data and data analytics

There are five short Skillnet courses in the big data and data analytics area planned for 2014 ranging from 3 to 15 days in duration. The ICT Skillnet networks are focussed on addressing this need for enterprises. The Summit Finuas Network works within the international financial services sector and has also found a demand for programmes in data analytics from its members. The ICT focussed networks are also delivering a range of courses related to this area. For example, some of the ISA Skillnet programmes in Cloud computing converging technologies are directly related to big data.

Table 6.6 Skillnet Short Courses Planned in the Big Data and Analytics Skills Area for 2014

Course Title	Network	Duration	Certified
Big Data Analytics	ICT Ireland Skillnet	3 days	No
Business Analytics with Big Data	ITAG Skillnet	3 days	No
Data Mining for Business Intelligence	ITAG Skillnet	3 days	No
Implementing Big Data Solutions with Hadoop and MapReduce	ITAG Skillnet	4 days	No
Higher Diploma in Science in Data Analytics	Summit Finuas Network	15 days	NFQ Level 8 certified

Source: Skillnet, 2014



6.3.7 Online education in data analytics

Table 6.7 provides examples of online courses available through some US universities and from online training providers. Stanford University provides free online programmes with training in subject areas relating to data analytics such as machine learning.

Table 6.7 Online Education in Data Analytics

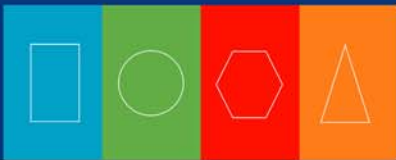
Course Title	Provider
Machine Learning	Stanford University
Introduction to Databases	Stanford University
Introduction to Artificial Intelligence	Stanford University
Model Thinking	Stanford University
Design and Analysis of Algorithms Part I & 2	Stanford University
Master of Information and Data Science (MIDS)	Berkley School of Information
BS/MS in Data Analytics	Southern New Hampshire University
Certificate in Data Analytics	Statistics.com
Online MSc and Professional Diploma in Data Analytics	UCD
Big Data University	Run by experienced Hadoop, Big Data and DB2 users

Source: Forfás, 2014

6.4 Conclusions on skills supply and matching with demand

This section has reviewed the current and planned supply of relevant data analytic talent in Ireland. A proportion of those who ultimately go on to work in big data and analytics related roles will have degrees in tailored analytics programmes. As the area grows in prominence, this number can be anticipated to increase. In relation to roles requiring deep analytical talent and supporting technology roles the main challenge will be to increase the numbers and quality to meet anticipated expansion demand. In relation to big data savvy roles the response required is a balance between filling new job opportunities and the upskilling of those already in employment. For supporting technology roles the EGFSN report on Addressing Future Demand for High-Level ICT Skills has highlighted the need to boost the numbers and quality of such roles. As a response a new Government High-Level ICT Skills Action Plan was launched in March 2014.

The supply of deep analytical talent is a particular challenge - both within Ireland and abroad. For a large number however, paths into deep analytical talent will be forged from a variety of complementary disciplines such as engineering, maths and physics. In aggregate the level of domestic output of relevant programmes would only be sufficient to fill the number of emerging deep analytics vacancies available if a significant proportion were to choose a career path in data analytics. In practice however, graduates from these disciplines are in high demand and tend to go

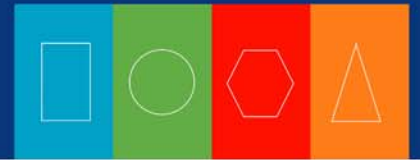


into many careers including investment banking, actuarial activities, and academia. Internationally, the proportion of graduates in these disciplines choosing emerging analytics careers is thought to be in the range of 10-20%.

Based on the information set out, for the most recent data available, there are in the region of 2,000 graduates per annum from the types of courses directly relevant to the “emerging deep analytics” cohort in Ireland.⁵⁸ Given that there is intense competition for such skills from other occupations, the goal over the period up to 2020 must be to both attract sufficient numbers from this talent pool into “emerging deep analytics” roles and at the same time increasing the size of the potential talent pool.

Section 8 sets out a range of recommendations aimed at increasing both the size of the available talent pool (through domestic supply, migration and up-skilling) and the proportion of relevant graduates choosing careers in analytics.

⁵⁸ As noted, the potential analytics talent pool is broad. Included for the purposes of this exercise are graduates at NFQ Level 8 and above in specialist analytics courses, courses with significant analytics components and maths / statistics and combined maths / computer science. Also included are NFQ Level 9 and 10 in physics and engineering.



7. Policy measures in place - domestic and international

7.1 Overview

This Section presents a flavour of the range of policy measures currently in place to assist in driving the skills supply of big data and analytics at both a domestic and global level. Understanding existing initiatives is important in setting the backdrop for current performance and potential future action. The value in setting out global initiatives in place is to inform potential recommendations inspired by leading international practice.

7.2 The race for analytics talent

Several countries have taken steps to develop and attract a supply of big data talent. For the purposes of this study, seven locations were selected for review: UK, Singapore, India, United States, Canada, Poland and Estonia.

Currently, North America and Europe have the largest share of new data stored globally. However, one of the crucial constraints with the exponential growth of big data is the challenge in finding and attracting the talent needed. Previously cited analysis suggests that there will be a global shortage of the big data and analytical skills needed to take advantage of potential growth. With a forecasted shortfall of 140,000 to 190,000 people with deep-analytical skills and a further 1.5 million data-savvy managers and analysts by 2018 in the US alone, it is seen that the 'race' for data analytics talent is on.⁵⁹

For Ireland to compete in this global market, action must be taken in order to develop supply through domestic education and training provision; continuing professional development of those at work; and through the attraction of talent from abroad. While it may prove relatively quicker to up-skill and train workers for data-savvy roles, the deep analytical talent cohort is anticipated to experience more acute skills shortages.

Globally, some countries have been quick to establish a steady supply of graduates equipped with the analytical skills needed for industry. MGI analysis showed that the US, China, India, Russia, Brazil, Poland, UK and France, in that order, have the highest graduate flow of people with deep analytical training (defined as people with advanced training in statistics and /or machine learning and who conduct analysis). Taking into account relative population size, Poland, Romania, the UK and France had the highest number of deep-analytic graduates per 100 people.⁶⁰

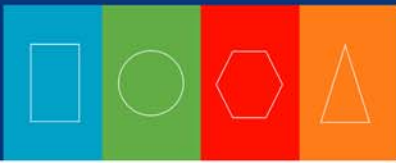
The quality of education is also crucial, and in developing countries especially, is seen as somewhat uneven. Global companies in developing economies typically only recruit from the top universities - for example just 1% of graduates in India come out of the top schools; in China the figure is 2% and in Brazil it is 6%.⁶¹

Section 7.3 summarises key initiatives underway to develop analytical talent in the countries studied (UK, Singapore, India, United States, Canada, Poland and Estonia).

⁵⁹ MGI (2011) Op.cit.

⁶⁰ MGI (2011) Op. cit.

⁶¹ Accenture (2013) Op.cit.



7.3 Trends in international policy approaches

A key emerging trend observed internationally is the interdisciplinary approach to big data and analytics education. This approach allows universities to re-orientate and / or leverage existing resources and collaboration across several departments including computing, business, statistics, marketing and economics. Accordingly, data analytics programmes are run under the auspices of varying academic departments within third level institutes, including business, engineering, computer science, statistics, and digital media departments. In some countries - for example in the USA - the majority are run through business departments.

In the UK, policy responses have included establishing Big Data Academies⁶² within educational institutes with the support of enterprise. This collaboration is designed to help build up an adequate supply of data analytics talent to meet industry needs.

This collaboration of industry with higher education is the key trend emerging internationally. Approaches to enterprise involvement include:

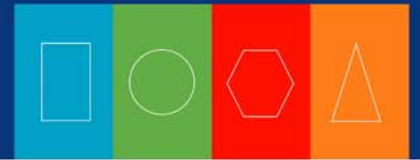
- Offering 'real world' work problems and large datasets to mine;
- Providing data analytics software and hardware;
- Providing relevant work experience opportunities;
- Shaping specialisms or electives within programmes (including the actual provision of the taught modules);and
- Promoting analytics as a career path for students.

There are also examples of undergraduate programmes which offer data analytics modules. These include the technologies for handling Big Data (Hadoop, MapReduce, Cassandra), the open-source data analysis package R, and feature refined business IT curricula. Such programmes include modules on business analytics and intelligence, which encourage students to recognise the potential business benefits within a dataset. Successful undergraduate courses include structured internship / co-op opportunities with industry that allow students to obtain valuable work experience before they graduate. These opportunities help to develop essential soft skills such as communications, team-working, leadership, creativity and critical thinking.

The majority of specialised big data / data analytics courses provided are at post-graduate level. Most of these are at MSc level (except in the case of India where many are at Certificate level). Post graduate MSc programmes aimed at both students and professionals are delivered full-time, part-time and also through online provision. They include programmes aimed at:

- STEM graduates with a core background in computer science and statistical knowledge to develop their expertise including in analysing and visualising large heterogeneous and real-time analysis of data associated with diverse 'real world' domains, including energy, the environment, health, media, medicine and transportation.
- STEM graduates developing their expertise in algorithms, data compression, knowledge representation and reading, and high performance computing - in combination with economics and business sciences - to bridge the gap between business and technology skills.
- The growing demand for data scientists with the right combination of technical and analytical skills by working on practical analytics problems through industry sponsored projects, in use of

⁶² <http://www.bcu.ac.uk/news-events/calendar/sas-student-academy-launch-and-careers-fair>.



data bases, data mining, algorithms and complexity theory, multivariate statistics, machine learning and data base processing.

- Students and professionals who wish to use data to create customer value and cultivate customer relationships through developing interactive digital strategies and gleaning customer insights and evaluating alternative customer segmentation opportunities.
- Preparing graduates for roles as strategic thought leaders who leverage predictive analysis and modelling to drive decision making using real world problems and situations. This would include project management skills.

Post graduate Diploma and Certificate level programmes include those aimed at:

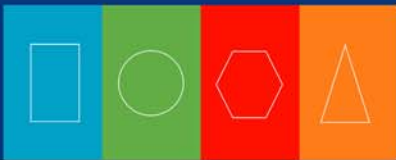
- Students with prior knowledge of statistics and programming to gain database skills to house, extract, manipulate and maintain data, assess its quality, analyse it, and present the information effectively to decision makers;
- Students and professionals in the use of the tools and techniques of analytics including data mining, computing, design of experiments, survey sampling, statistical inference, financial modelling, and advanced marketing research;
- Data Warehousing and Data Mining;
- Open Data technologies and opportunities for publishing, consuming and validating open and anonymised data; and
- Enabling practitioners, managers and decision makers in the use of advanced analytics for better decision making and linking these concepts to business cases.

There is a level of continuing professional development provision in big data / data analytics, including part-time and through distance and online provision. These include:

- Data Management and Statistical Analysis including data entry and manipulation, graphs and tables and basic statistical analysis;
- Brief overview of machine learning for managers; and
- Executive programme in business analytics and business intelligence.

Some countries (for example Singapore) are offering scholarships for talented students to pursue data analytics training programmes and careers after graduation. Singapore is seen as having the highest proportion of graduates who can be considered potential analytics talent (18%) owing to the high rate at which graduates pursue degrees in quantitative fields and the high quality of the country's education system. By comparison, only 7.5% of India's graduates are considered analytics talent - although it boasts the largest pool of analytics talent - with more than two million qualified graduates becoming available between 2010 and 2015.

These international examples illustrate the type of competitive landscape in which Ireland is operating and can assist in framing recommendations to enhance the pool of talent available here.



7.4 Initiatives in place in Ireland

The area of big data and analytics has grown in prominence in recent years in Ireland and policies are being pursued to maximise the potential for productivity, innovation and employment creation. Box 7.1 outlines the steps included in the Action Plan for Jobs (2013) to further drive this agenda.

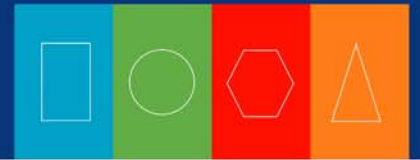
Box 7.1 Big data and analytics in the Action Plan for Jobs

The APJ (2013) sets out ambitious plans to make Ireland a leading country in Europe for big data and analytics. Underpinning this goal are several supporting actions. These are:

- Establish a joint Industry-Government Big Data Task Force to progress the Disruptive Reform.
- Undertake an assessment of existing and planned initiatives across Government and the private sector that can contribute to Ireland's reputation as a leader in the areas of data analytics and Big Data.
- In the context of assessment referred to in the previous point, identify and commence at least 2 new pilot initiatives whereby data analytics will be employed to address specific challenges delivering economic impact and/or improved public services.
- Progress the development of Ireland's National Action Plan on Open Government Partnership.
- Through the Department of Jobs, Enterprise & Innovation, further develop a critical mass of research activity and scale in the area of "Data Analytics, Management, Security and Privacy" in line with Government's priority areas for R&D.
- Enterprise Ireland and IDA Ireland to establish an industry-led Technology Centre in Data Analytics, facilitating linkages between enterprise and academic research; identifying and addressing barriers to collaboration.
- Take action to put in place an integrated national High Performance Computing (HPC) facility that will support Big Data/Data Analytics.
- Complete mapping exercises to explore in detail links between enterprise and academic expertise in various applications of data analytics.
- Provide funding for the platform science and technology areas underpinning data analytics.
- NSAI to identify appropriate mechanisms whereby Ireland can help to lead standards development activities linked to areas of data analytics and big data prioritised by the enterprise sector in Ireland; mobilise enterprise involvement in the appropriate working groups.

Allied to these supporting actions, a number of data analytics research centres have been established to drive the research agenda in this area. This research infrastructure can assist in capitalising on opportunities available in this area in the years to 2020.

The INSIGHT Centre for Data Analytics was established in July 2013 by Science Foundation Ireland with funding of €75m invested by both public and industry sources for research programmes spanning the next six years. INSIGHT is a joint initiative between researchers at UCC, UCD, NUI Galway, DCU and other partner institutes including Trinity College Dublin, NUI Maynooth, Royal Irish Academy and the Tyndall National Institute. INSIGHT brings together leading Irish and international academics to consolidate a national research platform and build critical mass in big data analytics. With over 200 researchers, INSIGHT works closely with industry partners to develop next-generation

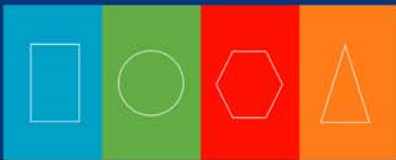


data acquisition and analytics solutions for important and diverse application areas. Founding partners include HP, Cisco, Avaya, Intel, Microsoft, and IBM. Challenges faced by industry inform INSIGHT's research direction to ensure that the research outputs have an impact in the broader economy. In this regard, they already work with many different types and size of organisation from 1-2 person start-up companies to multi-national corporations and governments. Research themes include Connected Health, the Discovery Economy, Digital Humanities & Journalism, Energy & the Environment, Sport & Wellness, Telecommunications & Networks and Media Processing.

CeADAR, the Centre for Applied Data Analytics Research, established in November 2012 aims to accelerate the development, deployment and adoption of Data Analytics technology and relevant innovations. CeADAR is supported by Enterprise Ireland and IDA Ireland and is led by UCD, UCC and DIT. Founding partners include Dell, eBay, Accenture, HP, Fidelity Investment, Nanthean Technologies, and Adaptive Mobile. CeADAR's initial research themes are based on technology challenges that have been identified by industry representatives; 'Intelligent Analytical Interfaces', 'Data Management for Analytics' and 'Advanced Analytics'. Close collaboration with a variety of IT companies is a key tenant of its work.

The Irish Centre for High-End Computing (ICHEC), Ireland's national high performance computer centre provides High-Performance Computing (HPC) resources, support, education and training for researchers in third-level institutes and, through technology transfer and enablement, supports the needs of industry in the areas of high performance computing and data management. ICHEC employs 25 computations scientists in Galway and Dublin and works directly with a number of industry partners in the areas of climate research, marine applications, environmental monitoring and land use applications. It was announced that Government support for ICHEC in the 2013-2015 period will amount to €8 million.

The Telecommunications Software and Systems Group (TSSG) is a centre of excellence for ICT research and innovation which partners with NUIM, NUIG, UCC, TCD and leading international institutes the three categories of skills. It's Data Mining and Social Computing Unit which has a staff of 20 focuses on the research and development of Data Driven Services (DDS). These are specific services that exploit and directly monetise the potential in large datasets. They are specifically designed to release the potential re-occurring revenue streams in operational data that is above and beyond market insights - effectively 'Tier Two of Data Analytics'. TSSG has partnerships with approximately 90 Irish based companies as well as having collaborated with 425 partners globally on research projects.



8. Findings and Recommendations

This Section synthesises the key findings emerging from the analysis and presents a set of recommendations designed to enhance the supply of talent available and ensure the realisation of the significant benefits available from big data and analytics.

The findings and recommendations are presented across core themes

- Building up the supply of analytics talent :
- Enhancing the employability of graduates and delivering relevant skills (relating to deep analytical talent and big and analytics savvy roles in particular) and focusing on the roles of all stakeholders, public and private;
- Appealing to the broadest possible talent pool - both domestically and internationally;
- Inspiring the next generation of analytics talent;
- Measuring progress; and
- Unlocking the potential of big data and analytics in the public sector.

These recommendations are made in the context of ongoing efforts to build up the pipeline of science, technology, engineering and maths skills at all levels of the education system.

The overarching recommendation is that a consultative group comprising representatives of industry, academia and relevant agencies should be established. This group would work over a six month period in order to oversee the implementation of the relevant recommendations.

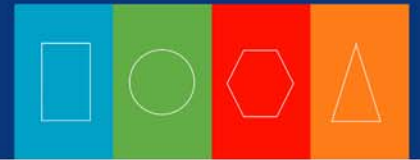
8.1 Building up the supply of analytical talent

In order to convince existing organisations and new inward investors that Ireland is able to meet future talent demand (while ensuring competitive wage levels and avoiding displacement of talent from existing firms) it is important that the talent supply is not only flexible but perhaps also available in advance of potential future demand. The latter point has implications for the timing for increasing the deep analytical graduate domestic output; bringing forward any necessary changes in the employment permit system; and enterprises role in the up-skilling for big data savvy roles.

In striving to realise the ambition set out in the *Action Plan for Jobs 2013* to make Ireland a leading country in Europe for big data and data analytics, the paramount challenge is ensuring that the appropriate pool of deep analytical talent is available. While firms surveyed are optimistic and ambitious in relation to employment opportunities, they expressed some concern in relation to talent supply.

A firm consensus is yet to emerge among companies as to the precise level of qualifications required to fill deep analytical talent vacancies. Some firms reported that a specialist degree in analytics or management science would be an ideal qualification; other companies reported a preference for Masters' and PhD graduates in quantitative and problem-solving areas such as engineering and maths. In either case, a considerable level of training and education specialism is required.

The clear message however is that firms are experiencing constrained skills supply. Given the breadth of the potential supply pool it is not possible to directly transpose supply onto demand in order to point to a specific quantum of skills gap. That said however, the firm position emanating from the key informant consultation and the enterprise interviews is that the risk of over-supply of



graduate talent is negligible. The combined view of stakeholders and employers is that there is sufficient demand to absorb a significant increase in the level of post graduate output which has had enterprise involvement / work placement. This underscores the need to continue to focus on expanding output including through INSIGHT and other relevant centres.

A clear finding of this review therefore, is that medium-term demand for analytics talent will support a significant uplift in the supply of graduates of sufficient quality with relevant skills at NFQ Levels 8, 9 and 10. There is variety in the roles in demand, in the backgrounds of the potential talent pool and in the level of technical skills required.

These factors must inform the policy response regarding skills supply. In some cases talent will be provided through ongoing measures such as the ICT Skills Level 8 Conversion Programme. This will be appropriate as a source of some of the skills for the supporting technology group. There may also be a case for extension or replication of this to assist in the building up of analytical talent. Analysis of Census 2011 data shows that there were some 7,500 holders of third level qualifications in science, maths and computing unemployed. Added to this, 11,400 holders of third level qualifications in engineering, manufacturing and construction were unemployed.

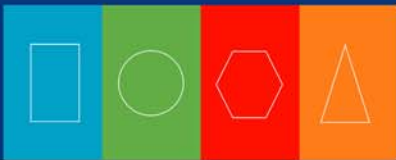
While this level can be expected to have reduced somewhat in the interim - and not all of this cohort will be suitable for a transition into a career in analytic - it nonetheless shows that there is a potential supply pool with numeracy and problem-solving skills that are currently unemployed. There may therefore be a case for the expansion of the data analysis element of the ICT conversion programme or roll-out of a specific analytics conversion programme. This would be targeted at numerate graduates and involve data management, mining and R, among other skills. The precise course content should be determined in consultation with industry.

For Ireland to become a leading country for big data a higher level of skills supply will also be required. This will involve an enhanced supply of Masters and PhD graduates along with an expansion of places on courses designed for those with advanced degrees in STEM to transition into high-end analytics. In response to the core finding from the consultations that a key barrier to filling vacancies is an insufficient level of experience among applicants, programmes must be designed in consultation with industry and incorporate work placements to the maximum extent possible.

A second central theme to emerge from the consultation is that as technologies and applications evolve, the skills taught in third level institutes must remain relevant to the needs of industry. This must include due regard for the mix of technical skills (including specific packages and applications), 'softer' skills such as communication, and business and domain knowledge. The enterprise consultation found that firms anticipate a changing mix of skills into the medium-term. As the balance of competencies required cannot be predicted with certainty at this juncture, it will be important to continuously monitor and revise course content as appropriate. This points to the potential opportunities for greater enterprise/education partnership, similar to the emergence of a Big Data Academy in the UK as described in Section 7.

These findings make it necessary to redouble efforts to improve the employability and experience levels of new graduates and inform recommendations 1-3.

The current prioritisation of research and teaching in data analytics should be reaffirmed and funding safeguarded. A proportion of funding for research in data analytics should be focussed on a challenge that will demonstrate to young people the power of big data and data analytics.



Enhancing the employability of graduates and delivering relevant skills (relating to deep analytical talent and big and analytics savvy roles in particular) requires the collaboration of all stakeholders, public and private.

1. Boost the output and quality of Deep Analytical Talent

- Enterprise and education providers should collaborate to increase the output and ensure the quality and relevance of deep analytics courses. Industry expert participation should be facilitated in course delivery. This would involve teaching modules and making datasets and other resources available which enhance the industry relevance of curricula and assignments. This could also involve delivering domain specific learning on specialist courses.

Time frame: Short to Medium-term
Lead: Higher Education Institutes, Companies

- Industry should work with higher education institutes to provide relevant structured work placements for students in analytics programmes and related disciplines.

Time frame: Short to Medium-term
Lead: Employer Bodies, Higher Education Institutes

- Enterprises in data analytic business activity should engage with the Irish Research Council's *Enterprise Partnership Scheme* and Employment Based Postgraduate Programme whereby Masters and PhD candidates undertake research work of direct relevance to that firm. The value of the schemes should be marketed to prospective companies, students and graduates.

Time frame: Short-term
Lead: Companies, Irish Research Council, Higher Education Institutes,

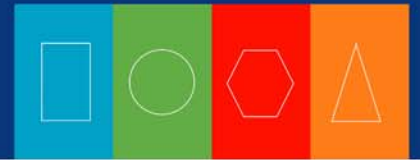
- Expand the provision of short courses to up-skill graduates from science and engineering disciplines. Review current post graduate data analytic course content and work with industry to ensure relevance. Thereafter, course content should be reviewed annually.⁶³

Time frame: Short to Long-term
Lead: Higher Education Institutes, Companies

- Business communication skills, critical thinking and project management skills should be taught across all STEM disciplines.

Time frame: Short to Medium-term
Lead: Higher Education Institutes

⁶³ This review process will be of most relevance to analytics-specific areas. In addition content in areas such as law and corporate governance should be reviewed to ensure relevance to emerging issues in data protection and related developments.



There is broad consensus in the literature - affirmed in the consultation undertaken - that the deep analytical talent pool will be most constrained and likely to suffer from supply shortages. This should not mean a sole focus on this group as it is also important that the education system caters for the needs of industry for data users who are big data and analytics savvy.

The analysis concludes that the core channel through which the big data and analytics savvy talent pool can be delivered in the short-term will be through up-skilling and retraining. Industry must drive this process. For developing the future pipeline of talent, the education system should focus on enhancing numeracy and quantitative skills more broadly and as a wide a variety of courses and disciplines as possible should involve teaching basic concepts in data management and analysis.

2. Increase the output and quality of Big Data and Analytics Savvy Roles

- Foundation and intermediate statistics and research methods feature on the curricula of business and social science courses should be updated to include an introduction to emerging analytics concepts and techniques (where this has not already happened).

Time frame: Short to Medium-term

Lead: Higher Education Institutes

- Executive education providers should develop courses in data analytics for decision-makers.

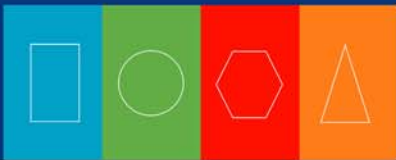
Time frame: Short to Medium-term

Lead: Business Schools, public & private colleges

- Handling data is becoming a core workplace skill and so foundation modules in statistical techniques and data management should be available to law and humanities students.

Time frame: Short to Medium-term

Lead: Higher Education Institutes



This study has shown the potential gains available from fully capitalising on big data and analytics. These benefits will primarily accrue to the enterprise sector. It is therefore critical that firms themselves lead the up-skilling of relevant talent to fill roles and grow and develop in this area.

3. Deliver relevant data analytic skills - the role of industry

- Improve senior executives understanding of the potential for big data and data analytics to enhance their business performance. An annual data analytics seminar highlighting best practice should be run and company case studies written up and circulated among employers.

Time frame: Short to Medium-term

Lead: Employer Bodies, IDA and Enterprise Ireland

- Firms should adopt an enterprise-wide approach to managing their data analytical capabilities, including the up-skilling of staff and for data protection and governance. Enhanced talent management and retention systems should be promoted. Analytical staff should be offered experience in a range of business functions to gain greater insight of commercial objectives.

Time frame: Short to Medium-term

Lead: Companies

- Industry should support the establishment of an Analytics Skillnet. This should especially target smaller firms and promote the adoption of analytics across sectors. This should be included by Skillnets in the next call for the establishment of new networks.

Time Frame: Short-term

Lead: Employer Bodies, Skillnet

- Expand the scale and delivery of flexible, accredited online data analytics course provision.

Time frame: Short to Medium-term

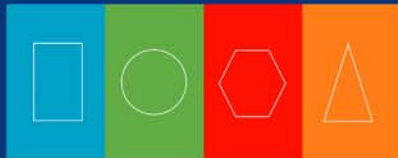
Lead: Public and private institutes, Higher Education Institutes, Employer Bodies

8.2 Appealing to the broadest possible talent pool

Talent available for big data and analytics roles can be sourced from a range of disciplines. Big data and analytics savvy roles will be filled from a wide range of sources, including business and humanities graduates. In aggregate, the flow of graduates from relevant disciplines could cater for the number of job openings likely to arise across the various scenarios. In practice however, analytics careers are just one potential career path for the cadre of skills emerging. Graduates in the relevant disciplines may choose careers in a range of sectors.

For the deep analytical talent cohort it is important that roles appeal to the broadest range of graduates. It is therefore critical that every effort is made to enhance the appeal of big data and analytics occupations in order to maximise the potential flow of talent available.

The enterprise consultation showed a number of hard to fill vacancies already, irrespective of future growth. Increasing the supply of skills is therefore an imperative in the short-term.



4. Appeal to the broadest potential pool of Deep Analytical Talent

- Employers should develop and communicate appealing career paths for individuals with deep analytical talent. This should include the opportunity to progress to senior data analytics specialist positions as opposed to general management, and lead to accreditation.

Time frame: Short to Medium-term

Lead: Companies, Employer Bodies

- Higher education institutes should utilise all channels to inform employers of the potential skills supply available from as wide a range of disciplines as possible.⁶⁴ Extensive outreach to students should be encouraged including college campus awareness campaigns and company open days.

Time frame: Short to Medium-term

Lead: Higher Education Institutes, Companies

- Employers and recruiters should emphasise the skills required - as opposed to preferred disciplines - in job postings. This can facilitate qualified applicants from non-typical disciplines.

Timeframe: Short to Medium-term

Lead: Companies, Recruitment Agencies

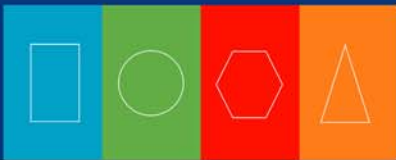
- Introduce targeted competitive funding available for post graduate specialist analytics programmes to reduce tuition fees, incentivise participation and increase places available.

Time frame: Short to Medium-term

Lead: Higher Education Authority, Higher Education Institutes

Given the forecast tightness in the big data and analytics labour market, it will be important to aim to attract talent from overseas to the extent possible. As IDA Ireland records further successes in securing investment from top corporate names in this area, Ireland can build on our growing reputation in order to draw the best global talent here. In time, this will be aided by broader efforts to enhance Ireland's reputation in this area. Ireland already has attracted a number of key global brands in the corporate sector. Into the medium-term, educational institutes should strive to develop analytics courses which are internationally renowned and can attract top global talent to Ireland to study.

⁶⁴ Along with STEM graduates, these will include, but not be limited to, the quantitative and computational social sciences, geography, life sciences and other areas where candidates have undertaken advanced quantitative training.



5. Promote Ireland internationally as the centre for Deep Analytical Talent

- The employment permit process should facilitate the attraction of skills in deep analytical talent from outside the EU/EEA. These should be added to the High Skills Occupations List in relation to the Green Card Employment Permit.

Time frame: Short-term

Lead: Department of Jobs, Enterprise & Innovation

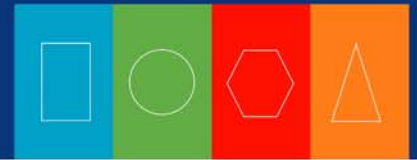
In addition to new recommendations made in this report, policy in this area will be reinforced with the implementation of two actions proposed in the EGFSN/Forfás study on High-Level ICT skills:

- Establish a single website with public and corporate involvement to proactively attract international talent.

Lead: Enterprise Ireland, IDA Ireland, Companies, Department of Social Protection (EURES)

- Organise career fairs abroad to attract high-level talent from abroad and expatriate talent, organised by a group of companies with actual jobs to fill.

Lead: Enterprise Ireland, IDA Ireland, Department of Social Protection (EURES), Companies



8.3 Inspiring the next generation of analytics talent

If Ireland is to become a leading country in Europe for big data and analytics, a step change in the awareness and image of the area is needed. While this will be a multi-faceted process, appealing to a new generation of talent will be pivotal, not least in order to boost the long-term pipeline of skills supply. A number of steps are proposed.

6. Inspire the next generation of analytics talent

- Enterprises should write up and make accessible case studies providing tangible information of career paths and interesting roles available in data analytics. Careers guidance in schools should communicate the availability of career opportunities in analytics to students (particularly females) and their parents. The problem-solving nature of analytics should be highlighted.

Time frame: Short to Long-term

Lead: SFI Discover, IDA Ireland, Enterprise Ireland, Companies

- Industry, higher education and awareness bodies should work together in collaboration with networks such as Coder Dojo to provide data analytics related project work such as the Apps4Gaps competition for young people.⁶⁵

Time frame: Short to Medium-term

Lead: Companies, SFI Discover, Higher Education Institutes

- Existing initiatives such as the *Smart Futures* programme should be used to communicate and promote analytics careers information to post-primary students, teachers and parents.

Time frame: Short to Medium-term

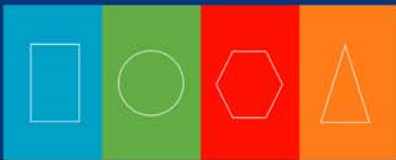
Lead: SFI Discover, Engineers Ireland, Companies

- An Analytics category should be added to the four existing categories in the *BT Young Scientist and Technology Exhibition*.

Time frame: Short-term

Lead: BT Young Scientist and Technology Exhibition

⁶⁵ Apps4Gaps is run by the INSIGHT Centre for Data analytics and NUI Galway and is open to primary, post primary and third level students. It invites students to create Apps using open data available from the 2011 census in areas such as transport, housing and planning. Apps4Gaps is a partnership between the Insight Centre for Data Analytics, the Central Statistics Office and Science Foundation Ireland in conjunction with the Department of Education & Skills, the Department of Education Northern Ireland, Project Maths, Coder Dojo and the Digital Repository of Ireland.



8.4 Measuring Progress

This report has set out the challenges inherent in measuring and forecasting big data and analytics activity. In order to monitor progress in this area in the future, robust data should be compiled on an ongoing basis.

7. Measure progress in big data and analytics employment

- Industry and State Agencies should work with the CSO and Revenue Commissioners to explore the possibility of further developing official measurements of big data and analytics employment.

Time frame: Medium to Long-term

Lead: CSO, Revenue Commissioners, Forfás

8.5 Supporting Actions: Unlocking the potential of big data and analytics in the public sector

Alongside the previous range of recommended skills-focused actions, a number of supporting actions, related to ongoing initiatives in other areas, are made aimed at unlocking the potential of big data and analytics in the public sector

A finding of this study is that the level of exploitation of the value of data and level of use of analytics in the public service is at an earlier stage of maturity than in leading countries.⁶⁶ The State has an unparalleled level of interaction with citizens through the delivery of public services, administration of the tax system and distribution of social transfers. There is therefore substantial potential for enhanced efficiency, cost savings and improved outcomes through deployment of analytics on a more widespread scale.

In the short-term, the introduction of post codes will build on the expanded data infrastructure achieved in recent years with the introduction of unique company and personal identifiers. The recently announced developments in relation to Open Government will also play a key role. While ongoing fiscal constraints and the public service numbers ceiling limit the capacity for investment to a degree, the Irish public administration has proved agile and responsive in the past and with a number of actions, will be able to realise gains in this area.

At a corporate level, Ireland is already home to a number of high profile enterprises - both foreign owned and indigenous - who are involved in applying cutting-edge analytical techniques. These companies should be encouraged to assist public bodies in applying similar techniques to public service challenges.

Into the medium-term, capacity should be developed within Departments and agencies. There is a well-established practice of hiring statisticians and legal professionals into dedicated roles in the civil service. This has recently been replicated through specialist recruitment to roles in economics,

⁶⁶ There are a number of notable exceptions, as noted throughout. For instance the use of analytics in aspects of tax administration in Ireland is an example of leading practice globally.



finance, human resources and tax administration. Into the future, analytics professionals can be hired in the same way.

8. Unlock the potential of big data and analytics in the public service

- Government bodies should undertake a review of data sources held and make open as much data as feasible. This would also act to encourage the development of groups around the use of open source data and free technologies and stimulate interest in data analysis.

Time frame: Short to Long-term

Lead: Chief Information Officer, Government Departments

- Increase efforts to build up the data infrastructure including the development of a unique business identifier.

Time frame: Short to Medium-term

Lead: Central Statistics Office

- Enterprises with significant data analytics capacity should be invited to assist Government bodies in carrying out demonstration projects to address specific challenges faced in the public service and illustrate the potential value of big data and analytics.

Time frame: Medium-term

Lead: Chief Information Officer, Government Departments, Companies, Employer Bodies

- Publish examples of successful deployment of analytics in the public services throughout the Government system in order to illustrate the potential benefits.

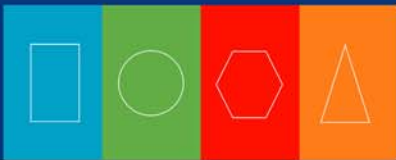
Time frame: Medium-term

Lead: Chief Information Officer

- Consider tailored recruitment to analytics jobs in the public service including academic positions specialising in teaching analytics skills, and the development of a Government Analytics Service to work on a cross-departmental basis to provide solutions to public service problems. An inventory of analytics skills and applications in the public sector should be compiled.

Time frame: Medium-term

Lead: Government Departments



8.6 Conclusion

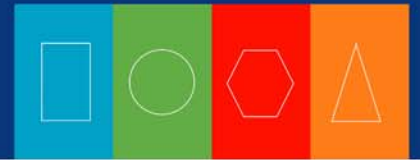
As is evident throughout this report, the economic and social benefits available from enhanced adoption of big data and analytics are potentially transformative. The spectrum of benefits on offer spans from improved health and environmental outcomes to better efficiency, higher productivity in industry and avoidance of waste, error and fraud. In delivering these outcomes there will also be major labour market benefits through high value, high skilled employment.

What is also clear from this report is that realising the available social and economic gains will require a determined and concerted effort from industry, education and Government in order to identify and overcome potential obstacles and realise the benefits available.

This can be achieved by:

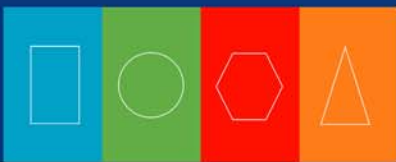
- Enhancing the employability of graduates and delivering relevant skills with a clear focus on the roles of all stakeholders, public and private.
- Appealing to the broadest possible talent pool - both domestically and internationally.
- Inspiring the next generation of analytics talent.
- Measuring and monitoring progress.
- Unlocking the potential of big data and analytics in the public sector.
- Reaffirming priorities in terms of the research agenda.

Taken together, the actions set out here represent a firm roadmap for building up the analytics talent pool in Ireland and assisting in achieving the medium-term vision of making Ireland a leading country in Europe for big data and analytics.



Appendix 1: Members of the Steering Group

Margaret Cox (Chairperson)	Member EGFSN
Vincent Mc Key	IBM
Edel Lynch	Accenture
Paul Forde	Glanbia
Peter Cosgrove	CPL
Conor Murphy	Datahug
Maurice Lynch	Nanthean Technologies
Richard Southern	Deloitte
Gerard Lande	Enterprise Ireland
Aidan Mc Cauley	IDA Ireland
Donal Flavin	IDA Ireland
Duncan Cleary	Revenue Commissioners
Grainne Morrissey	Department of Education and Skills
Tim Conlon	Higher Education Authority
Kevin Magee	Vidiro Analytics
Seán Mc Garraghy	Quinn School of Business, UCD
Marie Bourke	Forfás
Gerard Walker (Project Manager)	Forfás



Appendix 2: Terms of Reference

Introduction

The focus of this Study is on assessing the future demand over the period 2013-2020, for Big Data/Analytics skills across the economy. The Government's Action Plan for Jobs 2013 includes an initiative to make Ireland a leading country in Europe in 'Big Data' and establish Ireland's position as a global leader in the data and analytics sphere. Forfás and the Expert Group on Future Skills Needs are to "undertake a detailed assessment of the demand for data analytics and related skills to build on existing estimates and to explore the qualifications required, map the skills needs against existing programmes and take action through existing mechanisms to address gaps between supply and demand". Big Data/Data Analytics is an emerging field of work which does not fall into standard occupational definitions. Therefore, there is currently little information regarding the baseline for Big Data/Data Analytics talent in Ireland.

Background

The Government has set an ambition for Ireland to become a leading country in Europe in 'Big Data'. It is envisaged that this will help create significant additional employment in the economy. To do this a series of actions were recommended in Action Plan for Jobs 2013 to create an ecosystem based on public and private collaboration which will:

- Directly and indirectly create high-value jobs
- Strengthen the existing FDI proposition and attract new FDI from top global organisations
- Foster indigenous enterprise and innovation
- Attract and develop top talent in a high-value sector
- Create value through public and private sector productivity increases.

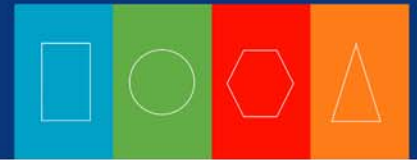
A joint industry - Government 'Big Data' Taskforce was established to drive these actions.

All of the above highlights the requirement for Ireland to build up a sufficient data analytics talent pool in order to take advantage of the potential business and employment opportunities in this area. It is essential that the necessary skills base is developed to drive the performance of data analytics business here in Ireland and capitalise on potential business and employment opportunities.

Objectives of the Study

The Study will focus on forecasting the future annual demand across the economy (over the period 2013 - 2020), for Big Data/Data Analytics and related roles including their qualifications, skillsets and competences requirement. This is likely to encompass the three broad categories below:

- "Deep Analytical Talent" skills requiring a combination of (i) advanced statistical, analytical, and machine learning skills (ii) business skills to assess the meaning of data and to derive business insights and (iii) communications skills to explain/persuade other executives. The shortage of such "deep analytical talent" internationally has been identified as the most acute talent constraint on potential Big Data / Data analytics business growth. These roles can originate from a range of backgrounds such as mathematicians, statisticians, actuaries,



operational research analysts, economists and include the newly termed role of the 'data scientist'.

- **“Big Data Savvy”**: comprising of “data savvy” managers, CIO’s, market research analysts, business and functional managers. These professionals require an understanding of the value and use of Big Data/Data Analytics to enable them to interpret and utilise the insights from the data and take appropriate decisions to advance their company strategy.
- **Supporting technology roles**; these personnel have the skills to develop, implement and maintain the hardware and software tools required to make use of Big Data/Data Analytics software and hardware. The growing demand for these skills is highlighted in the EGFSN report, ‘Addressing the Future Demand of High-level ICT Skills in Ireland’.

Methodology

The methodology comprises several integrated elements. These are outlined as follows:

A. Concise Literature Review

The focus of the concise review will be on any available international or domestic research that has been undertaken to establish the baseline employment of those engaged in Big Data/Data Analytics roles and their defined qualifications, skillsets and competences profile requirements.

B. Research exercise conducted through structured telephone interviews with companies, organisations and stakeholders.

The aim of this element is to (i) input into the estimation of the current baseline employment for Big Data/Data Analytic skills based upon a pre-defined profile of their roles and skill-sets required⁶⁷ (ii) identify the main trends and drivers impacting on the demand for skills up to 2020 on the numbers employed and their skillsets, competences and qualification requirements (iii) find out how the different roles interrelate to bring greater synergy and enhance company performance (iv) identify any current/anticipated skills gaps (v) consider how companies plan to address any such skills gaps including through new graduates employed on a sustainable basis; continuing professional development; or inward migration (vi) elicit proposals they would make in relation to building up an adequate talent pool in Ireland.

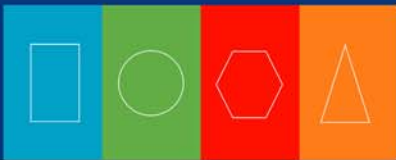
The information acquired through these interviews will also input into the assessment of demand for Big Data/Data Analytics talent, over the period 2013-2020, in element C.

C. The demand scenario exercise

This element will present an annual demand scenario for Big Data/Data Analytics skills across the economy, over the period 2013 - 2020. The baseline for the scenarios will be an estimation of the current employment of Big Data/Data Analytics talent across sectors. The demand scenario exercise will include an outline of the current and emerging qualifications, skillsets & competences required. The skills demand scenario will be broken down in terms of expansion and replacement demand requirements over the period 2013 - 2020. It is likely to encompass the three broad categories below:

- “Deep analytical talent”

⁶⁷ Exercises A can provide an input into this.



- “Big data savvy” managers
- Supporting technology professionals

The scenarios will depict a credible future for the demand for Big Data/Analytics skills based on key international and domestic drivers and trends and their impact on the level and nature of skills demand.

D. International review of actions taken by a selected range of countries to develop and attract a supply of Big Data/ Data Analytics talent.

Globally, some countries have been quicker at implementing education and training programmes aimed at bridging the large gap between supply and demand. This exercise will include an assessment of actions in a selected number of countries which have been identified as good examples.

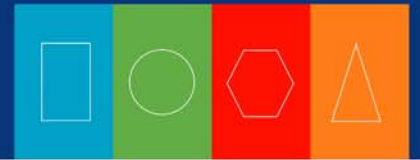
E. An assessment of the current and planned educational and training system supply of Big Data /Analytics skills at NFQ Levels 6/7 and 8/9/10.

This assessment will be categorised by:

- a) Those participating on specifically designed Big Data/Analytics programmes; and
- b) Those participating on programmes which comprise the broader potential supply pool for Big Data/Analytics talent.

Outputs

- A report with an Executive Summary, presenting the following:
- A demand scenario(s) over the period 2013-2020 of the annual numbers employed within Big Data/Data Analytics roles and their skills, competencies and qualifications requirements.
The employment demand scenario(s) will be broken down by expansion and replacement demand.
- Mapping of current and anticipated skills needs for Big Data / Data Analytics roles against existing/ planned programme provision and the identification of any current/anticipated skills gaps in skills provision.
- Recommendations made will advise on optimising the use of existing resources - both Government and the private sector.



Appendix 3: Dedicated Big Data & Analytics Programmes

Currently there are fifteen dedicated data analytics courses in Ireland with an enrolment of approximately 500 students. Four further programmes are planned for a 2014 or 2015 start. These programmes are predominantly at Level 8 and Masters Level/ NQF level 9. As the majority have only been recently set up only four had recorded graduate numbers in 2011.

Dublin City University recently introduced an MSc in Computing in Data Analytics in September 2013. The programme was designed in collaboration with IBM and will help graduate students to develop critical IT skills for urban analysis, consumer behaviour, social networks, sentiment analysis, healthcare, and cyber and network security. Students have access to real-world IBM case studies. The course is jointly delivered between industry experts from IBM and DCU academics.⁶⁸

Dublin Institute of Technology MSc in Computing in Data Analytics is designed to create 'hybrid technologists' i.e. graduates with deep technical skills (in data management, data mining, probability and statistics, and machine learning), but also with softer skills (in communications, research and problem solving). This programme is run by both the School of Computing and the school of Mathematical Sciences.⁶⁹

University College Cork Master's programme in Data Science and Analytics is run jointly between the Department of Computer Science and the School of Mathematical Sciences. The programme concentrates on data science, probability theory and statistics and provides graduates with an opportunity, through development of a research project, to investigate the more applied elements of the disciplines.⁷⁰

Smurfit Business School runs an MSc in Business Analytics, which is designed for candidates from Information Systems, Engineering, Maths, Economics, Science and Computing backgrounds. The programme allows students to evaluate real management problems with Irish companies as part of their dissertation. The course is offered on both a full-time and part-time basis. Core modules within the curriculum include Quantitative Methods, Numerical Analytics and Software, Project Management and Decision Analytics and Applied Probability and Statistics.

Trinity College Management Science and Information Systems Studies (MSISS) degree is suited to students that enjoy solving complex problems, who are interested in both technology and business. The four year course offers students the chance to build up skills in quantitative techniques in conjunction with business concepts in management, finance and operations management. Statistical analysis and data mining modules are compulsory for final year students.⁷¹

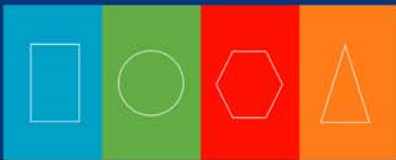
The Irish Management Institute in conjunction with **University College Cork**, offer a Higher Diploma leading to an MSc in Data Business. The programme is designed as an executive education programme for professionals who have technical experience and want to develop a more business/holistic view of data strategy and non-technical professionals who need to have a strategic understanding of how to manage data and collaborate with the data analysts. The programme content was developed in collaboration with EMC and SAS.

⁶⁸ <http://www.dcu.ie/news/2013/jul/s0713s.shtml>.

⁶⁹ <http://www.dit.ie/postgrad/programmes/dt228adt228bmscincomputingdataanalytics/>.

⁷⁰ <http://www.ucc.ie/en/media/studyatucc/postgrads/applicationdocuments/MScDataScienceAnalytics.pdf>.

⁷¹ <http://www.tcd.ie/courses/undergraduate/az/course.php?id=DUBCS-MSIS-1F09>.



The Institute of Technology Cork are running a NFQ level 8, year-long, ICT Conversion programmes specialising in data/ business analytics.

The National College of Ireland (NCI) are also running a NFQ level 8, year-long, ICT Conversion programmes specialising in data/ business analytics.

Three NFQ Level 8 Springboard courses were approved in NCI, NUI Galway and the Institute of Technology, Carlow.

Dublin Institute of Technology offers a Continuing Professional Development Diploma through Springboard in the related field of Financial Mathematics and Analytics. The Diploma is at NFQ level 8 and is geared towards students with a previous qualification in Engineering or IT. It combines elements of financial mathematics, statistics and modelling, together with the technical skills to perform the analytical requirements particular to the financial and business sectors.

The Institute of Technology Tralee offers a level 7 Springboard Certificate in Social Media and Web Analytics. Students will gain the appropriate skills to undertake advanced data analysis of critical back-end information to support businesses in measuring, monitoring and bench-marking website performance against that of key industry players.⁷²

The Institute of Technology Blanchardstown runs an NFQ level 6 Certificate in Programming for Data Analytics available through the Springboard initiative in. The course is two semesters long and aims to impart fundamental skills for database design, SQL, statistics and data analysis.⁷³

There are online options available for specialising in data analytics. These would be well suited to professionals already in the ICT industry who wish to up-skill or convert to data analytics.

UCD have introduced an online professional diploma in data analytics. The course aims to help students analyse and understand the large data sets that are regularly being created via the huge growth in freely available online information.⁷⁴

The Institute of Technology Blanchardstown offer a part-time two-year online MSc in Computing (Business Intelligence and Data Mining). It is primarily designed for graduates originating from a computer science background (NFQ Level 8 or Graduate Diploma or equivalent). The course is designed in collaboration with industry. ITB is also involved in the SAS Academy programme.

Several universities have data/business analytics courses in the pipeline for the coming years.

NUI Galway is in the process of designing a ME in Computer Science & Information Technology with a specialism in Big Data & Analytics for a 2014 start. NUI Galway also intend to introduce an MSc in Business Analytics for commencement in September 2015.

UCD is in the process of developing a BSc in Business Analytics to commence in September 2015.

⁷² <http://www.ittralee.ie/en/InformationAbout/Courses/ParttimeStudy/CertificateinSocialMediaandWebAnalytics/>.

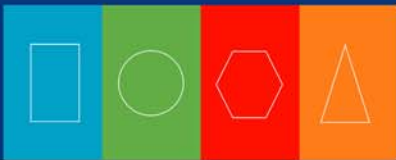
⁷³ <https://www.springboardcourses.ie/Certificate-in-Programming-for-Data-Analytics/Science-Mathematics-and-Computing/Computing/Computer-Science/ViewItem.aspx?ItemTypeID=2&ItemID=1679>.

⁷⁴ http://www.ucd.ie/science/graduate_studies/downloads/UCD_ProfessionalDiplomainDataAnalytics.pdf.



Appendix 4: Members of the Expert Group on Future Skills Needs

Una Halligan	Chairperson
Marie Bourke	Head of Secretariat and Department Manager, Education, Skills and Labour Market Policy, Forfás
Inez Bailey	Director, National Adult Literacy Agency
Peter Baldwin	Assistant Secretary, Department of Education and Skills
Ray Bowe	IDA Ireland
Liz Carroll	Training and Development Manager, ISME
Ned Costello	Chief Executive, Irish Universities Association
Margaret Cox	Managing Director, I.C.E. Group
Bill Doherty	Executive Vice President, EMEA, Cook Medical
Tony Donohoe	Head of Education, Social and Innovation Policy, IBEC
Bryan Fields	Director, Curriculum Development / Programme Innovation, FÁS
Sonia Flynn	EMEA Director for User Operations, Facebook
Anne Forde	Principal Officer, Department of Education and Skills
Joe Hogan	Founder, Chief Technology Officer and Vice President Openet Labs & IP Management
Jerry Moloney	Director of Skills, Enterprise Ireland
Frank Mulvihill	Former President of the Institute of Guidance Counsellors
Brendan Murphy	President, Cork Institute of Technology
Dermot Nolan	Department of Public Expenditure and Reform
Alan Nuzum	CEO, Skillnets
Muiris O'Connor	Higher Education Authority
Peter Rigney	Industrial Officer, ICTU
Martin Shanagher	Assistant Secretary, Department of Jobs, Enterprise and Innovation
Martin D. Shanahan	Chief Executive, Forfás
Jacinta Stewart	Chief Executive, City of Dublin VEC



Appendix 5: Publications by the Expert Group on Future Skills Needs 2011-2014

Report	Date of Publication
Regional Labour Markets Bulletin 2013	March 2014
Guidance for Higher Education Providers on Current and Future Skills Needs of Enterprise: Springboard 2014	February 2014
Addressing Future Demand for High-Level ICT Skills	November 2013
Monitoring Ireland's Skills Supply: Trends in Education and Training Outputs 2013	July 2013
National Skills Bulletin 2013	July 2013
Future Skills Requirements of the Manufacturing Sector to 2020	April 2013
The Expert Group on Future Skills Needs Statement of Activity 2012	April 2013
Guidance for Higher Education Providers on Current and Future Skills Needs of Enterprise: Springboard 2013	February 2013
Vacancy Overview 2012	February 2013
Regional Labour Markets Bulletin 2012	January 2013
Monitoring Ireland's Skills Supply: Trends in Education and Training Outputs 2012	July 2012
National Skills Bulletin 2012	July 2012
Key Skills for Enterprise to Trade Internationally	June 2012
EGFSN Statement of Activity 2011	April 2012
Vacancy Overview 2011	February 2012
Guidance for Higher Education Providers on Current and Future Skills Needs of Enterprise (<i>Forfás report based on EGFSN identified future skills needs</i>)	February 2012
Addressing High-Level ICT Skills Recruitment Needs: Research Findings	January 2012
Monitoring Ireland's Skills Supply: Trends in Education and Training Outputs	July 2011
National Skills Bulletin 2011	July 2011
EGFSN Statement of Activity 2010	May 2011
Developing Recognition of Prior Learning: The Role of RPL In the Context of the National Skills Strategy Upskilling Objectives	April 2011
Vacancy Overview 2010	March 2011



Appendix 6: Glossary of Acronyms

AIHP	Accenture Institute for High Performance
CeADAR	Centre for Applied Data Analytics Research
CI	Computational Intelligence
DDS	Data Driven Services
EGFSN	Expert Group on Future Skills Needs
FDI	Foreign Direct Investment
ICHEC	Irish Centre for High-End Computing
ICT	Information Communication Technology
INSIGHT	Insight Centre for Data Analytics
ISCED	International Standard Classification of Education
NFQ	National Framework of Qualifications
PPSN	Personal Public Service Number
SMEs	Small and medium sized enterprises
STEM	Science, Technology, Engineering, Mathematics
TSSG	Telecommunications Software and Systems Group

Expert Group on Future Skills Needs
c/o Forfás
Wilton Park House
Wilton Place
Dublin 2
Ireland

Tel: + 353 1 607 3000
Fax: + 353 1 607 3030
Email: egfsn@forfas.ie
Website: www.skillsireland.ie

