

A Study on harnessing Big Data for innovation led growth: an assessment of Ireland's progress and further policy requirements

A Report by IDC

Commissioned by the Department of Jobs, Enterprise and Innovation on behalf of the Taskforce on Big Data

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Table of Contents

Executive Summary	1
Big Data Market	1
Big Data Opportunities and Challenges in Ireland	2
Gap Analysis of Existing Policies and Initiatives in Ireland	3
Policy Recommendations and Action Plan	4
1. Introduction to Study	12
2. Study Methodology	14
3. Big Data Market Perspective	16
3.1 Definition	16
3.2 Big Data Value Chain	19
4. Analysis of Big Data Opportunities and Challenges in Ireland	21
4.1 Market Size and Forecast	21
4.2 Big Data Potential Impacts and Benefits	24
4.3 Big Data Industry in Ireland	25
4.4 Vertical Market Application of Big Data	28
5. Main Policy Challenges	33
5.1 Policy Challenges and the Data Value Chain	33
5.2 Big Data Policy Challenges for Ireland	34
6. Analysis of Main Policies and Lessons for Ireland	37
6.1 The Need for New Policies for Data-Driven Innovation	37
6.2 EU Data Policy	38
6.3 Major National Policies	42
6.4 Lessons Learned for Ireland	45
7. Gap Analysis of existing Policies and Initiatives in Ireland	48
7.1 R&D and Innovation Policy Actions	48
7.2 Supply-side Actions	50
7.3 Demand-side Actions	52
7.4 Open Data Actions	54
7.5 Enabling conditions	55

7.6	Gap Analysis summary	57
8.	Policy Recommendations and Action Plan	60
8.1	Introduction	60
8.2	Policy Recommendations	61
	Annex A - Vertical Market Opportunity Analysis	77
	Annex B - Main Sources	90
	Annex C - European Data Market Study	92
	Annex D - Taxonomy	93

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

Figure 1: Digital Transformation Ecosystem	16
Figure 2: The Data Value Chain and Ecosystem	20
Figure 3: Big Data Technology Stack	26
Figure 4: Big Data Vendors - Infrastructure and Data Management	27
Figure 5: Big Data Vendors - Hadoop Pure-Plays, analytical tools and applications.....	27
Figure 6: Big Data Vendors - Present in Ireland.....	28
Figure 7: Vertical Market Big Data "Heatmap"	29
Figure 8: Western Europe Big Data Activity by Vertical 2013	30
Figure 9: Big Data Value Chain.....	33
Figure 10: Telecommunications Sector Big Data Initiatives in Western Europe	77
Figure 11: Media Sector Big Data Initiatives in Western Europe	78
Figure 12: Financial Services Sector Big Data Initiatives in Western Europe	79
Figure 13: Utilities Sector Big Data Initiatives in Western Europe.....	81
Figure 14: Oil & Gas Sector Big Data Initiatives in Western Europe	82
Figure 15: Retail/Wholesale Sector Big Data Initiatives in Western Europe	83
Figure 16: Manufacturing Sector Big Data Initiatives in Western Europe.....	84
Figure 17: Professional Services Sector Big Data Initiatives in Western Europe	86
Figure 18: Transport Sector Big Data Initiatives in Western Europe	87
Figure 19: Government Sector Big Data Initiatives in Western Europe	88
Figure 20: Healthcare Sector Big Data Initiatives in Western Europe	89
Figure 21: The European Data Market Monitoring Tool	92

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

Table 1: Summary of Policy Actions.....	5
Table 2: Policy Actions	6
Table 3: Big Data Market Size and Forecast in Western Europe	23
Table 4: Big Data Market Size and Forecast in Ireland	23
Table 5: Big Data Market Share of Total Irish IT Market 2013 & 2018	24
Table 6: Number of IT Employees in Ireland 2011-2018.....	25
Table 7: Main policy Challenges for Ireland	36
Table 8: Main EU Policy Initiatives on Big Data - updated at 31 October 2014.....	38
Table 9: EC Communication Action Plan and Big Data PPP - Main Initiatives.....	40
Table 10: Investment Funding for Big Data in Some European countries, 2014.....	47
Table 11: Gap Analysis of Irish Policies - Summary.....	59
Table 12: Summary of Policy Actions	61
Table 13: Renew the Mission and Focus of the Big Data Taskforce.....	63
Table 14: Promote the Development of a Coherent Big Data Demand-Supply Ecosystem	65
Table 15: Review the Opportunity for Ireland to Leverage the Participation in the EU Big Data Value Partnership to Implement “Innovation Spaces” in Ireland	67
Table 16: Become a Leader in HPC for Big Data	68
Table 17: Identify and Promote More Scalable Big Data Pilots and Strengthen the Open Data Portal	70
Table 18: Raise Awareness of Big Data with a Focus on Promoting Trust and Confidence in Big Data Innovations	71
Table 19: Develop an Enterprise-driven Data Protection and Privacy Agenda	72
Table 20: Improve the Demand-Supply Match of Big Data Skills	74
Table 21: Develop and Promote Guidelines on Data Governance	75
Table 22: Develop and Promote a Digital Risk Management Culture and Guidelines for its Implementation by Enterprises	76
Table 23: Communications & Media Sector IT Spend in Ireland 2012-2018	77
Table 24: Financial Services Sector IT Spend in Ireland 2012-2018	79
Table 25: Utilities Sector IT Spend in Ireland 2012-2018.....	80
Table 26: Agriculture, Construction & Mining Sector IT Spend in Ireland 2012-2018	82
Table 27: Retail/Wholesale Sector IT Spend in Ireland 2012-2018	83
Table 28: Manufacturing Sector IT Spend in Ireland 2012-2018.....	84
Table 29: Professional Services Sector IT Spend in Ireland 2012-2018.....	85
Table 30: Transport Sector IT Spend in Ireland 2012-2018	87

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S
PROGRESS AND FURTHER POLICY REQUIREMENTS

Table 31: Government Sector IT Spend in Ireland 2012-2018 88

Table 32: Healthcare Sector IT Spend in Ireland 2012-2018..... 89

Executive Summary

In the 2013 Action Plan for Jobs (APJ) Big Data and Analytics was identified as one of the 9 Disruptive Reforms with resultant actions being targeted to make Ireland a leading country in Europe in the space. Within the APJ 2014 there was a requirement for the Department of Jobs Enterprise and Innovation (DJEI) to undertake an exercise to assess progress to date in achieving these aims and to identify actions that should be taken to build on/maintain this position. This report, commissioned by DJEI on behalf of the Taskforce on Big Data, and created by IDC, addresses this requirement.

Big Data Market

Big Data has become one of the "hot topics" in the technology marketplace in 2014 and is a core component of many organisations Digital Transformation strategy. Data analytics is not something new, it has been around since the early days of database technologies, but what is making this different today is that the technologies, both hardware and software, that are available mean that the speed with which data can be cost-effectively analysed and results interpreted have seen dramatic improvements. Additionally the volumes and types of data that are available to be used have grown in a way that is unprecedented and the ability for Big Data analytics to no longer require highly structured data as was the case previously has only added to this growth and the potential that is possible for the user.

Big Data has created its own industry within the overall IT industry with specialist suppliers and solutions covering infrastructure, data management, analytical tools and applications. Wrapped around all of this is a service industry helping organisations to design develop and deploy Big Data solutions, themselves or for their customers. Understanding this self-contained ecosystem is important in identifying where and how future policy intervention can be best placed to enhance Ireland's ambitions in the Big Data space.

It is often seen that when talking about Big Data a link is made between Big Data and Open Data (data sourced from third parties - public or private sector - that can then be combined with Private Data). Whilst a lot of data analytics being undertaken does indeed involve the partial or total use of Open Data, it is not a pre-requisite that all Big Data projects need to include Open Data. There are a vast number of Big Data projects being undertaken that utilise only the organisation's own data and this will continue to be the case in the future.

The use of Big Data has provoked a whole discussion about data privacy and data security and with it exposed flaws in the relevant laws across many countries around the world, leading to new legislation being drafted that seeks to not only protect the individual but also allow the benefits and value of data analytics to be realised.

Big Data Opportunities and Challenges in Ireland

Globally the Big Data market is growing at a fantastic rate with IDC estimating a CAGR rate of 26.24% for the period from 2014 to 2018. At a local level Ireland is actually expected to grow even faster with a CAGR of 30.0% over the same period, with a total market worth \$80.4m by 2018. Infrastructure (hardware, and networks) will continue to hold a larger share of the market since it is a necessary component to permit the analysis of such large volumes of data. However the services sector also continues to grow rapidly and it is here, along with the development of niche applications and solutions that we see the biggest potential in the short term for Ireland. In part this is due the level of investment being lower and the lag between deciding to initiate the process and being able to generate profitable revenues being much shorter as there is little or no capital investment or building work required.

When it comes to the leading global IT industry players, and more specifically those with an interest in Big Data, Ireland is well positioned with most of the big name players having a significant presence in the country. This all helps to create a strong ecosystem to encourage further investment and development in Big Data capabilities.

Big Data is touching each and every vertical market. Some historically data intensive businesses, such as telecommunications, oil and gas exploration, retail and financial services have rapidly adopted the concept and been very much at the pioneering edge of the sector. Other sectors such as Government, healthcare and manufacturing are starting to visualise and develop solutions that allow them to exploit the value of the data they already have and also look to using third party data to augment this. There is sound logic why Ireland has a lot to offer across all of the sectors named above. It has an educated skills base and a business population that includes many of the leading players in the sectors. Developing expertise and specialism in Big Data solutions not only services the domestic market but also addresses the needs of businesses in other countries around the world which in turn creates the potential to earn valuable foreign currency.

As already identified Big Data relies heavily upon the use of large and powerful computing resources. For some their needs can be addressed through the purchase of their own equipment, or through Cloud based resources if the need is perhaps infrequent. However for others they need a scale of computing that goes beyond this and leads them to need to access what is referred to a High Performance Computing (HPC). These resources are both highly specialised and also very costly and as such it is not uncommon for a facility to be built in a country, often linked to an academic institution, and then made available for a fee to third parties. Ireland is in the fortunate position of having an HPC centre (one of the few in Europe) within its ICHEC facility and leveraging such assets could further enhance the potential for the country to be seen as a leading provider of Big Data skills and resources.

The skills challenges for Ireland are not unique to Ireland; skill sets need to be able to service the demand for Big Data solutions with individuals who are both experienced in Big Data and also business. Business will only look to develop a presence in a location if they perceive the necessary skills are available there and likewise the skills will only look to reside in locations where the opportunity exists for them to be utilised in a rewarding manner. During the course of the interviews for this study a recurring theme was that whilst progress had been made to create newly qualified graduates who were knowledgeable about Big Data these were in the main technical skills rather than commercial skills and the lack of people within businesses who had the vision to understand how to exploit the potential that Big Data analytics could deliver the organisation were holding back the full realisation of the potential available.

Gap Analysis of Existing Policies and Initiatives in Ireland

Harnessing Big Data as a source of economic growth requires the development of an innovative ecosystem, sustaining the implementation of the data value chain and prioritizing the areas where Ireland can build on specific competitive advantages. Ireland is a small, open economy with already good potential positioning in the Big Data market, as shown by the potential growth of Big Data revenues estimated by IDC for the next years.

Based on IDC research and main public sources we have identified the main policy challenges to be met by Ireland in order to achieve leadership in the Big Data market. Then, we have carried out a systematic review of the current Irish Big Data policies and initiatives, their current progress and to what extent they cover the main policy challenges identified above. The result is a gap analysis highlighting the policy areas where further action is needed in order to develop successfully the Big Data market and industry. This assessment is based on best effort and we are confident that the main conclusions are reliable. However, given the breadth and multidisciplinary nature of the policies reviewed, we may have missed specific developments or very recent actions.

The overall picture emerging from this policy review and gap analysis shows that Ireland has moved fast to meet the R&D challenges of the Big Data market, but this may not be sufficient to achieve its goal of European leadership. From the summary analysis we can see that for most policy challenges there is a need for further action.

R&D and Supply Policy

Ireland's investments in R&D are timely, and based on the evidence, the choice to develop a network of specialised research centres is a good starting point to achieve a recognized leadership in the development of data analytics and privacy enhancing technologies. It is important that these investments are continued. There is however more that can be done to stimulate the development of a competitive Big Data industry. Ireland does have proactive innovation policies (such as the Entrepreneurship Disruptive Reform) but does not have more focused measures incentivising Big Data start-ups and promoting the development of data infrastructures and platforms, so that Ireland can become a "data hub" for the industry. The focus of current Big Data policies is mainly on R&D and data skills, disregarding the need for supporting the development of a balanced demand-supply ecosystem with a strong interaction between innovative suppliers and advanced users.

Demand Policy

The demand-side policies appear to be limited, even if there are some active measures and progress in terms of the support to organisational change and data-driven innovation (for example through the Innovation Vouchers programme). The development of the Open Data portal goes some way towards building the basis for "government leading by example", as well as the fact that one of the two Big Data pilots currently ongoing is by a government department. However, the stakeholder interviews underlined that there is a lack of awareness about the potential of Big Data among businesses, especially SMEs. There has been attempts recently by the CeADAR Technology Centre to raise awareness of the value to business of Big Data through open day events, and this could be built on further. Among citizens there is either ignorance or concern about potential privacy threats. The main policy gaps therefore concern the development of policies to promote awareness of Big Data potential opportunities and benefits, an important pre-condition for the development of the market, and the development of practical measures incentivising enterprises to extract, valorise and share their data.

Enabling Conditions

Big Data is a potentially disruptive innovation raising new and little understood challenges in multiple regulatory domains: we have identified the need for new governance frameworks, possibly with a holistic approach taking into account all of the data cycle, dealing with data ownership, sharing, interoperability, the implications of the data economy for competition and potential market abuse, and for social impacts on inequality and information asymmetries. The Irish government is starting to address some of these regulatory challenges, for example through the proposed Data Sharing and Governance bill, but there is still much to do. This will help in building trust and confidence in the data market, which goes beyond a simply defensive approach (insuring citizens that they will be protected from privacy violations).

Finally, there is one area which Ireland has prioritized correctly with a policy plan: meeting the demand for Big Data skills, improving supply through a mix of education, training and collaboration with industry. The lack of Big Data skills could be the single most important barrier preventing Ireland to achieving its goal of leadership in this market. There is widespread concern in Europe and the world about the lack of data scientists and data workers. Ireland has moved timely and is addressing the right actions, but the actual implementation of the policy plan should be a high level priority.

In conclusion, Big Data policy so far has been seen as essentially a technology innovation policy. In our opinion, to achieve the goal of Irish leadership in this market, greater coordination with other policy strategies is required, to maximise synergies with innovation and entrepreneurship policies. The Big Data strategy should be even more deeply embedded in the overall Irish growth strategy.

Policy Recommendations and Action Plan

Based on the Gap Analysis review the main policy recommendations are summarised as follows:

- R1 Renew the mission and focus of the Big Data Taskforce with a supervisory role of the Big Data Action Plan in order to make sure that progress is made towards Ireland's leadership in the area of Big Data, which is the main goal of the disruptive reform
- R2 Promote the development of a coherent Big Data demand-supply ecosystem
- R3 Review the opportunity for Ireland to leverage the participation in the EU Big Data Value Partnership to implement "innovation spaces" in Ireland
- R4 Become a leader in HPC for Big Data
- R5 Identify and promote more scalable Big Data pilots and strengthen the Open Data Portal
- R6 Launch awareness campaigns promoting trust and confidence in Big Data innovations
- R7 Develop an enterprise-driven Data Protection and Privacy agenda
- R8 Prioritize a focus on data skills development for the Big Data market, including education, training and attractiveness actions
- R9 Develop and promote guidelines for data ownership and control, access, sharing and interoperability, with a holistic policy approach
- R10 Develop and promote a digital risk management culture and guidelines for its implementation by enterprises

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

The main actions for implementing each recommendation are presented in the summary table below, referencing the policy challenge they respond to. Some of the actions may be relevant for more than one policy challenge.

Table 1: Summary of Policy Actions

R&D / SUPPLY SIDE CHALLENGES	DEMAND-SIDE CHALLENGES	ENABLING CONDITIONS
1. R&D Actions: 2.1; 2.2; 2.3	6. Data-Driven Entrepreneurship Actions: 2.3; 2.5; 2.6; 3.1; 5.1	10. Data Governance Frameworks Actions: 7.1;9.1
2. Competitive Big Data industry Action: 2.5; 2.6	7. Data Supply Chains and Provision of Shared Data Sets Actions: 2.4	11. Build Trust and Confidence Actions: 6.2; 7.1
3. High Speed Internet Implementation of National Broadband Plan in progress and should be continued'	8. Awareness Actions: 5.1; 6.1; 6.2	12. Supply Data skills Actions: 3.1; 4.1; 4.2; 8.1; 8.2
4. Data Infrastructures and Platforms Action: 4.1;4.2	9. Government leading by example; providing Open Data Sets Actions: 5.2	13. Open Data Portals and Standards Actions: 5.2
5. Develop a coherent demand-supply ecosystem Action: 2.3;2.4;2.6; 3.1; 4.1; 4.2;5.1		14. Security and Risk Management Actions: 10.1; 10.2

The core focus of each action, the timeframe in which the action should be taken, those responsible for the action and finally the challenge the action is addressing are summarised in the table below. Timeframe indications can be summarised as:

- Short Within the next 12 months
- Medium By 2018
- Long 2018 and beyond

**HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S
PROGRESS AND FURTHER POLICY REQUIREMENTS**

Table 2: Policy Actions

R1 Renew the mission and focus of the Big Data Taskforce with a supervisory role of the Big Data Action Plan				
Actions		Timeframe	Owners	Challenge being Addressed
1.1	Renew the mission and focus of the Big Data Taskforce with the goal to oversee progress towards the strategic goals of the Disruptive Reform.	Short	DJEI	Overarching Recommendation
1.2	Identify and adopt specific targets of the Big Data Disruptive Reform including measurable KPIs.	Short	Big Data Taskforce	Overarching Recommendation
1.3	Monitor progress annually, based on the KPIs, and produce a report updating/revising the main actions.	Annually	Big Data Taskforce	Overarching Recommendation
R2 Promote the development of a coherent Big Data demand-supply ecosystem				
Actions		Timeframe	Owners	Challenge being Addressed
2.1	Reinforce and continue funding the research and networking activities of the R&D centres in Ireland.	Short	DJEI , SFI, EI, IDA	1 R&D
2.2	Ensure that the activities of the R&D centres extend across the full RD&I spectrum including supporting go-to-market, applied research projects with business actors, for example with a co-funding model, and also providing consulting and skills training for the exploitation of data-driven innovation.	Short	DJEI , SFI, EI, IDA	1 R&D

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

2.3	<p>A Big Data industry focused group should be convened to:</p> <ul style="list-style-type: none"> • Review the R&D Tax Credit guidelines in order to determine whether the existing R&D tax credit system in Ireland supports the types of activities being undertaken in the area of Big Data. • Develop a shared understanding by industry as to how the R&D tax credit guidelines can be utilised to support Big Data applied research and implementation projects. • Engage with the Office of the Revenue Commissioners to determine how any uncertainties or gaps identified in the R&D tax credit system might be addressed for Big Data. 	Medium	DJEI, Office of the Revenue Commissioners	<p>1 R&D</p> <p>6 Data-Driven Entrepreneurship</p> <p>5 Develop ecosystem</p>
2.4	Incentivize enterprises to collect their own data and make it available for sharing in an anonymized and aggregated form.	Short	Department of Finance, DJEI	<p>5 Develop ecosystem</p> <p>7 Develop Data supply chains and data sharing</p>
2.5	Provide specific incentives and access to funding and mentoring schemes to start-ups and small innovative enterprises developing Big Data innovation, also leveraging the Entrepreneurship Disruptive Reform in the Action Plan for Jobs 2014.	Medium	DJEI, EI	<p>2 Competitive Big Data Industry</p> <p>6 Data-driven Entrepreneurship</p>
2.6	Explore the extent of EI programmes to see how they can be developed to include Big Data.	Short	EI	<p>2 Competitive Big Data Industry</p> <p>6 Data-driven Entrepreneurship</p> <p>5 Develop ecosystem</p>

**HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S
PROGRESS AND FURTHER POLICY REQUIREMENTS**

R3	Review the opportunity for Ireland to leverage the participation in the EU Big Data Value Partnership to implement “innovation spaces” in Ireland			
	Actions	Timeframe	Owners	Challenge being Addressed
3.1	In consultation with Big Data R&D centres, review the opportunity for Ireland to launch an innovation space in 2015, with a view to taking a lead position in selected application development areas whilst leveraging co-funding by the EC within the Big Data V-cPPP.	Short	Insight, H2020 High Level Group	5 Develop ecosystem 6 Data-driven Entrepreneurship 12 Supply Data skills

R4	Become a leader in HPC for Big Data			
	Actions	Timeframe	Owners	Challenge being Addressed
4.1	Ireland should expand its HPC Big Data related activities by promoting the early adoption of Big Data technologies particularly by start-ups and SMEs, through co-funded projects, ad-hoc consulting, the provision of test beds and access to HPC resources, and Big Data skills training. In order to do this Ireland should increase competitive funding for HPC.	Medium	DJEI, EI, IDA, SFI	4 Data Infrastructures and Platforms 5 Develop ecosystem 12 Supply data skills
4.2	Ireland should put a priority focus in identifying and pursuing opportunities to extend access to and engagement with HPC infrastructure, particularly for SMEs, through H2020.	Medium	H2020 High Level Group	4 Data Infrastructures and Platforms 5 Develop ecosystem 12 Supply data skills

**HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S
PROGRESS AND FURTHER POLICY REQUIREMENTS**

R5 Identify and promote more scalable Big Data pilots and strengthen the Open Data Portal				
Actions		Timeframe	Owners	Challenge being Addressed
5.1	Launch call for proposals for innovative pilot projects to be co-funded by the state. Develop criteria to select pilots with the highest potential for scalability, identifying the sectors where Ireland is strongest and is more likely to achieve leadership.	Short	Big Data Taskforce, DJEI, EI, IDA, SFI	8 Building awareness 6 Data-driven entrepreneurship 5 Develop ecosystem
5.2	Continue investing into the Open Data Portal, focusing funding to make available public data sets ready for exploitation and use.	Medium	DPER, Implementation group on Open Data, relevant Government Departments and Agencies	9 Government leading by example 13 Open Data Portal and Standards
R6 Launch awareness campaigns promoting trust and confidence in Big Data innovations				
Actions		Timeframe	Owners	Challenge being Addressed
6.1	Raise awareness of Big Data across enterprises and web entrepreneurs with a focus on impacts, on data availability and use, showcase of good practices and pilots and through the use of awards.	Medium	DJEI, EI, IDA, SFI	8 Awareness building
6.2	Raise awareness of Big Data value and benefits for citizens so as to build trust and confidence and to explain how to manage and limit privacy risks.	Long	Department of An Taoiseach	8 Awareness building 11 Build trust and confidence

**HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S
PROGRESS AND FURTHER POLICY REQUIREMENTS**

R7		Develop an Enterprise-driven Data Protection and Privacy Agenda		
	Actions	Timeframe	Owners	Challenge being Addressed
7.1	Ireland should develop a policy agenda on Data Protection and Privacy issues taking into account Big Data business development and competition requirements, and bring this agenda forward at the EU level, in order to avoid the creation of unforeseen barriers for enterprises in the implementation of the forthcoming revised Directive.	Short	Department of an Taoiseach	11 Build trust and confidence 10 Data Governance Frameworks

R8		Prioritize a focus on data skills development for the Big Data market		
	Actions	Timeframe	Owners	Challenge being Addressed
8.1	Implement the Actions of the EGFSN Report 'Assessing the Demand for Big Data and Analytics Skills'.	Short	DES, HEA	12 Develop data skills
8.2	Utilise and evolve existing schemes to support training and upskilling of professionals or employees with a business/ICT background in the Big Data field.	Medium	HEA, IRC, SFI	12 Develop data skills

R9		Develop and promote guidelines for data ownership and control, access, sharing and interoperability, with a holistic policy approach		
	Actions	Timeframe	Owners	Challenge being Addressed
9.1	Develop and promote guidelines for firms on the governance of data including competitive issues, ownership and control, access, sharing and interoperability, with a view to incentivise data sharing and interoperability.	Medium	DJEI, Data Protection Authority	10 Data Governance Frameworks

**HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S
PROGRESS AND FURTHER POLICY REQUIREMENTS**

R10	Develop and promote a digital risk management culture and guidelines for its implementation by enterprises			
	Actions	Timeframe	Owners	Challenge being Addressed
10.1	The Irish government should support the analysis of new digital risks created by Big Data and encourage industry to create guidelines to deal with them.	Medium	DJEI, EI, IDA, SFI	14 Security and digital risk management
10.2	Data controllers and enterprise decision makers in the public and private sector should be required to implement a Big Data digital risk management strategy if they receive State funding for Big Data activities.	Medium	DJEI, DPER, IEI, IDA, SFI	14 Security and digital risk management

1. Introduction to Study

The Irish government identified Big Data and Data Analytics as one of its 9 Disruptive Reforms in the Action Plan (APJ) for Jobs 2013, with an overall ambition to “build on existing enterprise strengths to make Ireland a leading country in Europe in the area of Big Data and Data Analytics”. The aim of the disruptive reform is to exploit the employment potential of ‘Big Data’ in Ireland by putting in place a partnership between the public and private sectors that will strengthen all aspects of the ecosystem for this opportunity area. During 2013 and 2014 a number of significant initiatives and investments have been progressed, in partnership with the enterprise sector in the area of Big Data and Data Analytics, including:

1. The establishment of a Taskforce on ‘Big Data’.
2. The completion of a mapping of infrastructure and initiatives supporting ‘Big Data’ in Ireland.
3. The identification and subsequent establishment of pilot projects to demonstrate the impact of ‘Big Data’.
4. The launch of Insight, the SFI-supported research centre for data analytics.
5. The launch by Enterprise Ireland and IDA Ireland of the CeADAR Technology Centre in data analytics.
6. Publication by the Expert Group on Future Skills Needs and Forfás of a study of skills demand in ‘Big Data’.
7. Launch of an Open Data initiative in the context of Ireland’s membership of the Open Government Partnership (Ireland became a member in July 2014). As part of this initiative an Open Data portal was launched (July 2014). More broadly, the initiative will further strengthen the mechanism 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 further strengthen Ireland’s national data infrastructure.

With a view to determining Ireland’s status within Big Data and Data Analytics in Europe and identifying areas that need to be addressed, Action 73 of the APJ 2014 specifically called for an exercise that “assesses Ireland’s progress in developing a leadership position in Europe in this area and sets out further requirements to build/maintain this position”. It is the purpose of this study to deliver on Action 73 of APJ 2014, and the aims of this study are as follows:

- Identify specific policy issues arising from opportunities identified for Ireland with regards to reaping societal and economic benefits through unlocking the potential of ‘Big Data’ in the public and private sector and how they should be addressed.
- Recommend a detailed implementation plan of practical actions with associated timelines (both immediate and medium to long term), actors and financing options (if appropriate) that will support Ireland in addressing these policy issues and opportunities in a systematic manner.

This report is structured as follows:

- Chapter 2 outlines the methodological approach undertaken for the study.
- Chapters 3 and 4 presents a perspective on the Big Data market, followed by analysis of the opportunities and challenges in Ireland with regard to the Big Data market size and vertical market applications.

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

- The main Policy Challenges identified for Big Data are highlighted in Chapter 5.
- An overview of Big Data policy approaches at the EU and OECD level are provided in Chapter 6, followed by an overview of key policies in a range of European countries.
- A gap analysis of existing Big Data Policies and Initiatives for Ireland is presented in Chapter 7.
- Chapter 8 presents the series of recommendations, and associated actions, as to how Ireland needs to proceed in order to address the main policy challenges in the area of Big Data.

Annexes containing supporting information are referenced throughout the Report.

IDC would also like to thank staff from The Department of Jobs, Enterprise and Innovation (DJEI) for their support in bringing this study to its successful completion.

2. Study Methodology

In preparing this report, IDC undertook a number of important activities to gather insight on how the adoption of Big Data is progressing in Ireland, to understand the challenges Ireland faces in developing a specialism in Big Data and to develop recommendations on the policy initiatives Ireland could adopt in order to accelerate the growth of the Big Data industry.

One major policy challenge concerns promoting the supply of data skills. On this topic, this study leveraged the conclusions of the report by the Expert Group on Future Skills Needs (EGFSN) “Assessing the Demand for Big Data and Analytics Skills, 2013-2020”, as specifically requested by DJEI. Based on our analysis, IDC provided some further reflections and indications on the best way to meet this data skills challenge.

The work undertaken by IDC to develop this report can be summarised as follows:

Existing Research on Big Data Market

As a leading provider of insight and advice into the technology industry IDC is continuously investigating and reporting on topics that are of key importance to the market. Clearly Big Data is a topic that is of significant interest to our clients and as such we are publishing a significant number of reports on this topic. We are also actively engaged on a number of consulting projects on this topic with clients who are themselves, vendors, end users or policy makers. In the course of this study we have been able to draw upon and use this considerable wealth of knowledge.

We have also drawn on research that has been published by or on behalf of other bodies such as the European Commission and the OECD.

Data Gathering from Stakeholders

Core to the project was the need to gain insight from representatives of key stakeholder groups regarding their views as to the challenges and opportunities that existed and what needed to be done to maximise the positive impact of Big Data to the Irish economy. This insight was gathered via:

- Telephone interviews with 25 individuals who represented the broad stakeholder community; including academia, end user organisations, technology industry and government bodies¹.
- A workshop held in Dublin in late October 2014 at which some 30 additional stakeholders attended to provide further insight and feedback on the current and potential state of the Big Data industry in Ireland.

Policy Analysis

The policy analysis was carried out by the IDC study team as follows:

- Desk research on data-driven innovation and relative policy challenges, based on main public sources such as the OECD;
- Analysis of the main policy strategies and initiatives for Big Data carried out at the EU level and in a number of EU Member States, as well as level of investments;

¹ Stakeholder interviews included interviews with 7 indigenous and 8 multinational firms.

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

- Identification of the main policy challenges for Ireland, based on the Data Value Chain model and ecosystem developed by IDC for the EC DG CONNECT in an ongoing study focused on the measurement of the European data economy²;
- Review of the current Irish policy initiatives and analysis of their progress to date, based on the stakeholder interviews and the documentation provided by DJEI;
- Mapping of the Irish policy initiatives on the main policy challenges for Ireland, evaluation of progress and gap analysis of challenges not yet covered by policy measures;
- Production of recommendations on policy initiatives to be taken to reach the objective of Ireland's leadership in Big Data;
- Development of an Action Plan, identifying specific actions for each recommendation, the responsible owners, their timeframe, their expected outputs, and suggesting types of Key Performance Indicators to be considered for measuring progress.

² See Annex C for details.

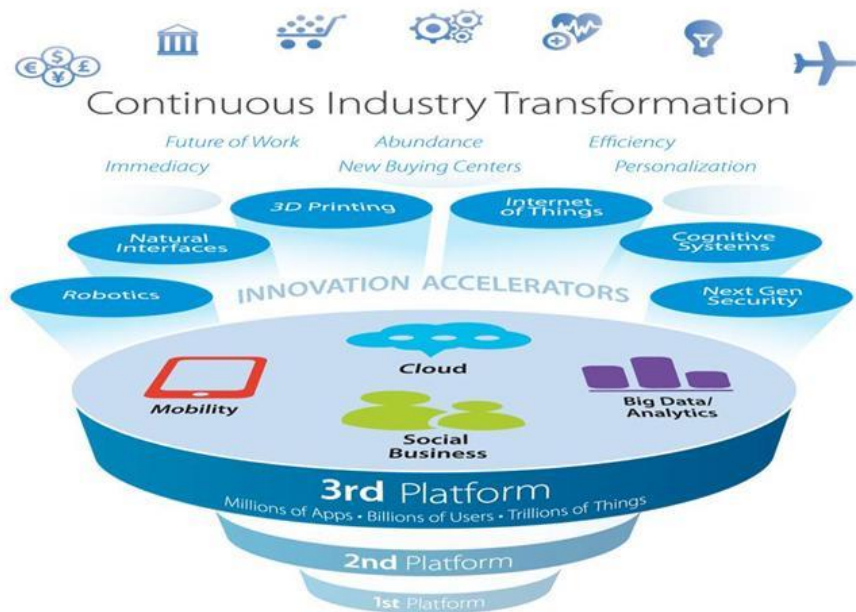
3. Big Data Market Perspective

The market hype around Big Data is substantial, and continues to grow. Big Data is in one sense an evolution of what business analytics has been doing (under various names) for over two decades. However, from a technology perspective, Big Data comprises a set of genuinely new technologies (examples are Hadoop, highly scalable databases, advanced data visualization tools and high-performance search engines) and a convergence of more mature technologies (examples are event-driven processing, business intelligence and data mining).

One thing that is certain from two decades of experience with business analytics, to fully embrace Big Data, organizations need to be dedicated and determined to embrace a more information-led culture. Many will seek third party assistance in defining and implementing their Big Data strategy and this will create the greatest job creation opportunity as those skills can not only service their domestic market but also markets overseas where sufficient or suitable skills are not available.

Big Data is a core component of what IDC has referred to as the 3rd Platform (Figure 1). Combined with Mobility, Cloud Computing and Social Media these components are driving a Digital Transformation that is changing the way in which we view technology and how it impacts our lives.

Figure 1: Digital Transformation Ecosystem



Source: IDC 2014

3.1 Definition

What is Big Data?

IDC defines Big Data technologies as a new generation of technologies and architectures designed to extract value economically from very large volumes of a wide variety of data by enabling high-velocity capture, discovery, and/or analysis.

This definition encompasses hardware and software that integrates, organizes, manages, analyses, and presents data that is characterized by the "four Vs":

- **Volume** – Large and increasing quantities of data that could reach up to petabytes (and more)
- **Variety** – Multiple types of data (structured, unstructured, semistructured), in combination
- **Velocity** – The speed that data arrives and the speed of analysis, ranging from batch to streaming data and keeping in mind the speed of both business processes and users' decision requirements
- **Value** – Increasing business value from Big Data analytics vs. decreasing technology prices

The importance of each of these attributes varies depending on the specifics of each industry or even organization. While the first three attributes of Big Data are defined in terms of technical characteristics, the fourth attribute, value, is defined by the perceived value of the data and the technology to any given organization.

Volume: Size Is Not the Only Thing That Matters

While the word "Big" in Big Data alludes to massive volumes of data, as noted previously, users must understand this as a relative term. Some industries and organizations are likely to have mere gigabytes or terabytes of data as opposed to the petabytes or exabytes of data associated with some of the social networking organizations. Nevertheless, these seemingly smaller applications may still require the intense and complex information processing and analysis that characterize Big Data applications.

The financial services industry demonstrates this variability. When engaging in certain Big Data activities, there may be millions or billions of records to consider, but each record may only be several bytes long (such as stock ticker information). Conversely, email archives may accumulate several petabytes of data containing valuable customer suggestions or complaints, records of projects, legal records, contracts, and proposals. The email archive usually contains the best record of pending and current business, but it needs to be sorted and mined to find out what it contains. Another good example is product design and manufacturing, where automotive and aerospace companies, for example, may evaluate hundreds or thousands of virtual prototypes to home in on the best vehicle design. The new large-scale scientific experiments that generate petabytes of mixed data a day as input into a complex simulation model are another example.

Variety: The Combination of Data Sources and Formats Is What Matters

Variety in Big Data is a critical attribute. The combination of data from a variety of data sources and in a variety of formats is a key criterion in determining whether an application can be considered as Big Data.

Big Data applications typically combine data from a variety of data sources (typically both internal and external to an organization) and of different types (structured, semi structured, and unstructured). This is an important facet of Big Data for both technical and potential impact reasons. Combining types of information is a complex technical challenge: What is the relative importance of a tweet versus a customer record? How do you combine a large number of changing patient records with published medical research and genomic data to find the best treatment for a particular patient?

An example of this may be the mash up of internal operational data with semi structured data from Web log files that identifies customers' online behaviour, with sentiment analysis of unstructured text from customer comments.

Another example is advanced weather/climate modelling that draws on 100 years of weather data with new physical models of ocean water behaviours and CO2 level changes, mixing in satellite data feeds to create a real-time simulation.

Velocity: Speed at Which Information Arrives and Is Analyzed and Delivered

The velocity of data moving through the systems of an organization varies from batch integration and loading of data at predetermined intervals to real-time streaming of data. The former can be seen in traditional data warehousing and is also the primary method of processing data using Hadoop today. The latter is the domain of technologies such as complex event processing (CEP), rules engines, text analytics and search, inferencing, machine learning, and event-based architectures in general.

The key to evaluating velocity requirements of Big Data is to understand the business/organizational processes and requirements of end users. For example, hedge funds need to identify and understand emerging investment trends immediately – seconds can make a difference. Similarly, real-time face recognition is a requirement for airport screening of travellers, to catch criminals as they enter airports. However, Web search engines – the source of MapReduce and Hadoop – must process and mine billions of queries to determine the accuracy of their algorithms or ad matching but don't need to perform that analysis in real time. In other words, the right information at the right time with the right degree of accuracy is what's needed.

The technology infrastructure for each use case differs. There is an old adage in the infrastructure community – you can solve any problem if you throw enough hardware at it. And, when one considers the large supercomputers that have been built, or the massive clusters that have been created to address specific problems, that adage holds true.

Increasingly however in today's world, the need for specialized hardware is not always necessary to meet high-performance demands. The combination of high-availability clustering, scale-out file systems, multi-CPU, and multicore processors means that the performance that can be delivered today leveraging common off-the-shelf (COTS) components is likely to be sufficient for many situations. Socialytics applications are often delivered via cloud, making consideration of the hardware unnecessary. However, for some there is always the need for more power to achieve what they require and Big Data projects are constantly pushing the boundaries of what is achievable, it is also fuelling the imagination of what might be possible. For this reason, the demand for access to specialist high performance computing environments continues to grow.

Value: Capital, Operational, and Business Benefits All Matter

In the context of Big Data, value refers to both the cost of technology and the value derived from the use of Big Data. The cost variable is important because it is a key defining factor of what's new with Big Data. Large data warehouses in financial services, telecommunications, and retail, R&D and government organizations have existed for years. Real-time data management in trading, weather monitoring, or fraud detection applications has existed for years. Unstructured content analysis in the form of text mining has existed for years. High-performance computing systems for scientific research have existed for years.

What is different now is that systems that were previously affordable and available only to government agencies or to a few of the largest companies in select industries are now available to the broader market. A combination of open source software and decreasing hardware prices has made these technologies more affordable.

Value also refers to the benefits derived from Big Data projects. These benefits can be broadly classified as:

- Capital cost reduction. A reduction in software, hardware, and other infrastructure costs.

- Operational efficiency. A reduction in labour costs due to more efficient methods for data integration, management, analysis, and delivery.
- Business process enhancements. An increase in revenue or profit due to new or better ways of conducting business, including improvements to commercial transactions, sustainable management of communities, and appropriate distribution of social, healthcare, and educational services.

3.2 Big Data Value Chain

The Big Data market represents a disruptive innovation affecting multiple sectors. There is a new ecosystem which is emerging to exploit data-driven innovation, generating a complex value chain cutting across multiple sectors. Figure 2 below presents a view of the emerging data value chain and the data ecosystem, based on the research carried out by IDC on behalf of the European Commission to measure the European Data Market³.

Figure 2 outlines the 4 main phases of activity comprehended by the data value chain and identifies the main stakeholder categories, including the data holders; the suppliers of data applications, tools, data management, data infrastructure; and data users.

The four phases of the value chain are the following:

- Collection/access of data from myriad of sources within the applicable legal framework. Collection can be direct (for example through loyalty schemes operated by retailers, transport and hospitality service providers) or indirect (for example by recording the location of someone using a cellular phone). Data can be also created through an analysis rather than being captured;
- Storage and aggregation by service providers and social networks, but also by companies in traditional sectors such as finance, retail, transport, utilities, government;
- Processing and analysing data, marketing and distribution, merging data from different sources (public, proprietary or institutional research) and relying on analytics to derive insights and value. Traditional players across vertical markets can perform this task if they have the necessary skills/technology; alternatively they can rely on external data brokers and providers;
- Usage, both in the public and private sectors to better serve customers and/or improve efficiency. The usage of data is broken down between primary use (when data is used for the goal for which it is collected: for example mobile traffic data to bill customers by a telecom company) and secondary use or re-use (when data is exploited for other goals, for example when mobile traffic data is used to map customers movements for a retail company). Re-use is expected to be the source of much of the value added of the data market.

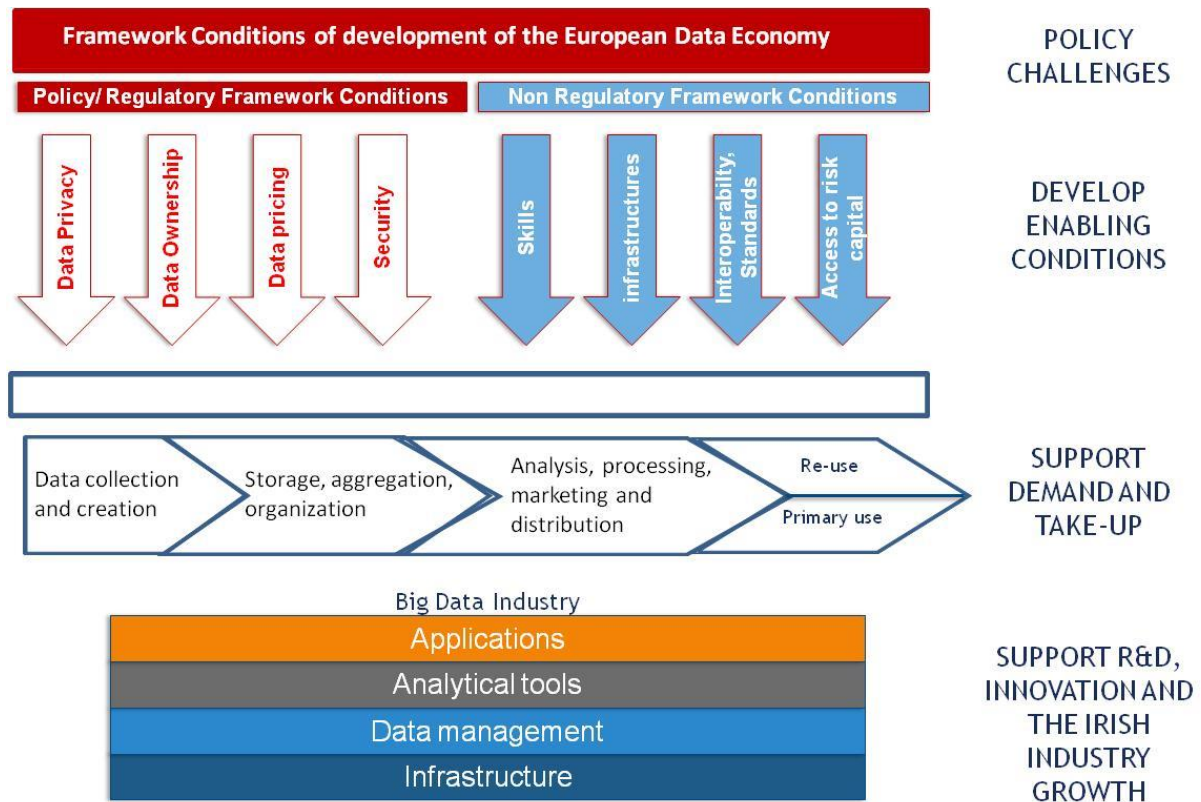
Notice that data holders (any organization generating data, from government agencies to banks) can use their own data but also share it or supply it to others for re-use. Some large data holders are vertically integrated and have entered the market to provide data-based services, for example telecom providers own huge data sets tracking consumers' choices and movements, which can be exploited commercially through Big Data tools and applications. More often, new start-ups or smart innovators will develop Big Data tools and technologies and act as specialized intermediaries between data holders and data users. Therefore the demand-supply interaction in this market is very close and includes many feedback loops.

³ See Annex C for further detail of this work

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

As for every emerging market, there are also framework conditions enabling its development, classified into regulatory and non-regulatory. Both types of framework conditions are extremely relevant to ensure the development of a balanced ecosystem: the main policy strategies developed at the EU and national level generally address the development of the data industry and the fostering of the enabling framework conditions.

Figure 2: The Data Value Chain and Ecosystem



Source: IDC 2014

Concerning the emerging data industry, we have identified multiple stakeholders with multiple roles, but it is clear that the leading global web platforms such as Amazon, Google and Facebook dominate the whole value chain; their vertical integration and their market dominance represent a huge competitive advantage. The best options for the EU data industry fall into the "new intermediary" categories (start-ups, data companies focused on data analytics and data-based services and apps) and the vertically integrated suppliers (such as the telecom providers, able to both provide and use data on a large scale). Developing favourable framework conditions (such as for example the development of a Digital Single Market in Europe, and supporting start-ups) is extremely important for the EU industry, and clearly also for the Irish industry who have the potential to play an active, even leading, role in the creation of this data value chain. This outcome underpins the thinking behind the policy recommendations in this report.

4. Analysis of Big Data Opportunities and Challenges in Ireland

This section of the report looks at the size and expected growth of the market, the structure of the market, the key players in the market and how different vertical market segments are adopting Big Data to address specific business issues. Finally, a summary of key opportunities in the Big Data industry and vertical markets is presented.

Since the forecasts provided here have been made prior to any new policy intervention to encourage Big Data adoption, the data provides a baseline against which the impact of future policy action and other forms of intervention can be measured. Likewise when looking at how policy intervention might be enacted within different segments of the end user community and within that the usage of Open Data, the vertical market analysis provides insight in to the areas of business that are being considered most aggressively when it comes to the use of Big Data.

4.1 Market Size and Forecast

Global Perspective

The hype surrounding Big Data appears to be tempering down. However, this is a sign of the set of technologies maturing – and making its way into the fabric of how organizations operate and firms conduct their business. IDC believes that, while Big Data will continue to represent a fast-growing multibillion-dollar worldwide opportunity for the next five years, overall growth of the individual segments that make up this market are starting to show signs of a slowdown. Big Data has and will continue to transform businesses everywhere – making them "Big Data driven" in the process. In the context of the broader ICT market and even the overall business analytics market, the Big Data market is quickly moving from a state of nascence to a state of maturity. Even with that change in sight, IDC expects lots of innovation to continue in the software, infrastructure, and services segments of the Big Data market. IDC is not changing its position that beyond the forecast period, the distinction between what is Big Data and what is not may blur to the point where it becomes meaningless. Therefore at some point, IDC may merge the Big Data market into the broader Big Data and analytics market. The findings of this forecast indicate that⁴:

- The global Big Data technology and services market will grow from \$16.55 billion in 2014 to \$41.52 billion in 2018. This represents a compound annual growth rate (CAGR) of 26.24% or about six times that of the overall information technology market. Infrastructure will continue to command a lion's share of the market with 48.2% share in 2014.
- Big Data has become a truly global phenomenon. While the Americas region is expected to continue leading the way in Big Data investments, the rest of the world is quickly catching up. EMEA and APJ commanded nearly a 45% market share in infrastructure, software, and services segments of the Big Data market (the remaining share was for the Americas).
- In 2013 and 2014, several new suppliers with innovative solutions entered the market. Between 2009 and 2013, VCs invested around \$3 billion in Big Data start-ups. Innovative solutions span all levels of the Big Data technology stack (see Section 4.3 below). IDC expects this to make this market ripe for M&A in 2015.

⁴ IDC Black Book 2014

- Not to be left behind in the Big Data market, incumbent suppliers are also fighting back hard to maintain their leadership. Suppliers are introducing new concepts and technologies such as data lakes as a means to continue to jockey for an attractive position in this complex market. IDC also expects incumbent suppliers to eventually go on an acquisition spree in the Big Data market.

Europe and Ireland Perspective

The challenge to generate value from data increases every day, taking into consideration the variety of data sources, expanding data volumes (IDC's Digital Universe study 2014 sizes the data in the world in 2013 at 4.4ZB, growing to 44.0ZB by 2020), and the increasing need to respond to events like sensor inputs, product faults, and customer tweets in real time. This, combined with the recent market hype around Big Data, has led many organizations to give serious consideration to Big Data and analytics technologies.

Western European (WE) organizations are rapidly catching up with their North American peers in terms of analytical maturity despite later adoption due to smaller datasets, a challenging economy, and skills shortage. The regulatory framework is also a differentiating factor between the US and Europe. The European Data Protection legislation (currently under revision) responds to greater concerns amongst EU citizens about data privacy and requires the provision of greater levels of protection of data. This is, on the one hand, a barrier to some kinds of exploitation of data sets, but on the other hand an opportunity for EU companies developing privacy enhancing technologies of interest for some international markets. There is some concern among EU ICT vendors that the forthcoming revised Data Protection Directive will strengthen privacy protection requirements and act as a Big Data market inhibitor. However, these inhibitors notwithstanding, the European Big Data market will exhibit rapid growth over the forecast period, and vendors will continue to jockey for an attractive position in this complex market. Technology and business process innovation across the software, infrastructure, and services segments will continue as vendors learn from their leading-edge customers how best to articulate value gained from their Big Data projects.

Key takeaways include:

- IDC expects the Big Data technology and services market in Western Europe to grow from \$2.3 billion in 2013 to \$6.8 billion in 2018. This represents a compound annual growth rate (CAGR) of 24.6%.
- From a country perspective, CAGRs range between 22.3% and 32.2%. Country market growth depends on a number of factors: existing maturity with analytics, economic situation (which varies hugely across Europe, from Germany to Greece), openness to new technologies, and interest from the academic community.
- Segment wise, the fastest-growing market segment is storage with a five-year CAGR of 30.5%, while the slowest are software and services, both at 21.9%.
- In the period to 2018 Ireland is expected to show one of the strongest rates of growth amongst the EU28 countries

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

Table 3: Big Data Market Size and Forecast in Western Europe

\$m	2011	2012	2013	2014	2015	2016	2017	2018	2013-2018 CAGR (%)
Storage	164.8	327.8	536.1	736.8	973.5	1,252.6	1,591.7	2,028.4	30.5
Server	207.5	229.4	314.2	430.7	518.5	618.5	745.6	864.9	22.4
Networking	50.3	75.8	109.8	153.0	204.7	263.1	325.6	388.8	28.8
Infrastructure total	422.6	633.0	960.1	1,320.5	1,696.7	2,134.3	2,662.8	3,282.0	27.9
Software	584.3	609.2	698.0	827.1	1,038.3	1,250.1	1,482.8	1,881.8	21.9
Services	394.4	493.1	592.6	733.1	907.5	1,114.2	1,348.8	1,593.1	21.9
Total WE Big Data market	1,401.3	1,735.3	2,250.7	2,880.7	3,642.5	4,498.5	5,494.5	6,756.9	24.6

Source: IDC Black Book 2014

Table 4: Big Data Market Size and Forecast in Ireland

\$m	2011	2012	2013	2014	2015	2016	2017	2018	2013-2018 CAGR (%)
Storage	1.5	3.5	4.3	5.5	8.4	10.7	14.0	17.1	31.5
Server	3.6	3.4	5.5	10.0	13.1	17.9	22.0	28.6	38.8
Networking	0.6	1.0	1.4	2.0	2.7	3.6	4.5	5.7	32.5
Infrastructure total	5.8	7.9	11.3	17.5	24.2	32.2	40.5	51.4	35.4
Software	3.6	3.5	4.0	4.6	5.6	6.6	9.3	10.4	21.2
Services	4.3	5.4	6.4	7.8	9.6	11.7	16.1	18.6	23.8
Total Irish Big Data market	13.6	16.8	21.7	29.9	39.4	50.5	66.0	80.4	30.0

Source: IDC Black Book 2014

IDC estimates (Table 5) that in 2013 Big Data accounted for less than 0.5% of the total IT market in Ireland. By 2018, based on current predictions which largely ignore the impact of any specific policies being put in place to accelerate the adoption of Big Data in the economy IDC expects to see

the share of the overall spend on Big Data (the amount of money spent by businesses and other entities within Ireland on IT products and services to support Big Data initiatives) more than treble.

Table 5: Big Data Market Share of Total Irish IT Market 2013 & 2018

	Market Size 2013	Big Data Share of Spend 2013	Market Size 2018	Big Data Share of Spend 2018
Infrastructure	\$2,174m	0.52%	\$2,412m	2.13%
Software	\$856m	0.47%	\$990m	1.05%
Services	\$1,843m	0.35%	\$1,998m	0.93%
Total	\$4,804m	0.45%	\$5,401m	1.49%

Source: IDC Black Book 2014

The successful outcome of policy Initiatives would expect the overall spend on Big Data to increase. This additional increase in Big Data spend will also see the overall size of the IT market rise, although at a lower rate due to some of this "new" spend being diverted from existing programmes and projects. However it would be anticipated that the Big Data share of the total spend would increase in this scenario.

To put Ireland in context, whilst the size of the market is small, that is more a function of the overall IT market in Ireland than anything else. As a proportion of the total market (0.46% in 2013) this is very much in line with other Western European countries including UK, France and Germany. Only Norway, Sweden, Denmark, Belgium and Switzerland have a Big Data market that exceeds 0.5% of the Total IT market in their country. Looking at future growth Ireland is positioned even better having the highest CAGR (30.0%) for the period 2013-2018 of all the Western European countries, except Austria (31.6%). Denmark has the lowest growth level at just 19.2% CAGR 2013-18 with Switzerland and Norway only just ahead at 20.0% and 20.1% respectively. The opportunities for IT businesses to grow and develop on the back of Big Data initiatives within Ireland are therefore better than elsewhere. This also ignores the potential for those businesses and associated skills to also find opportunities in other countries.

4.2 Big Data Potential Impacts and Benefits

The successful creation of a Big Data industry in Ireland has the potential to deliver a number of significant benefits. Big Data has the potential to drive both greater efficiency in the organisation and the people it serves but also create new products and services, which previously would not have been possible.

In 2012 Gartner⁵ predicted that for every IT job created as a result of a Big Data initiative an additional 3 non-IT jobs would also be created. Clearly there will be some job reductions as well, as analytical activities currently being done manually are automated (and potentially improved) with the adoption of Big Data.

Table 6 below provides IDC's estimates of the number of employees within the various layers of the IT ecosystem in Ireland.

⁵ <http://www.gartner.com/newsroom/id/2207915>

Table 6: Number of IT Employees in Ireland 2011-2018⁶

	2011	2012	2013	2014	2015	2016	2017	2018	CAGR 2012-2018
Broad ICT Sector	40,502	43,280	46,190	49,270	52,500	55,780	59,050	62,250	6.2%
Other Sectors	24,848	25,000	25,300	25,600	26,290	27,130	28,010	28,930	2.2%
Total	65,350	68,280	71,490	74,870	78,790	82,910	87,060	91,180	4.9%

Source: IDC 2013

IT Professional employees are individuals who are working within an end user organisation, Hardware, Services, Software and Channel employees are individuals who are working for an IT related manufacturer, developer, professional services or indirect channel business servicing the needs of an end user organisation directly or indirectly.

4.3 Big Data Industry in Ireland

Technology Stack

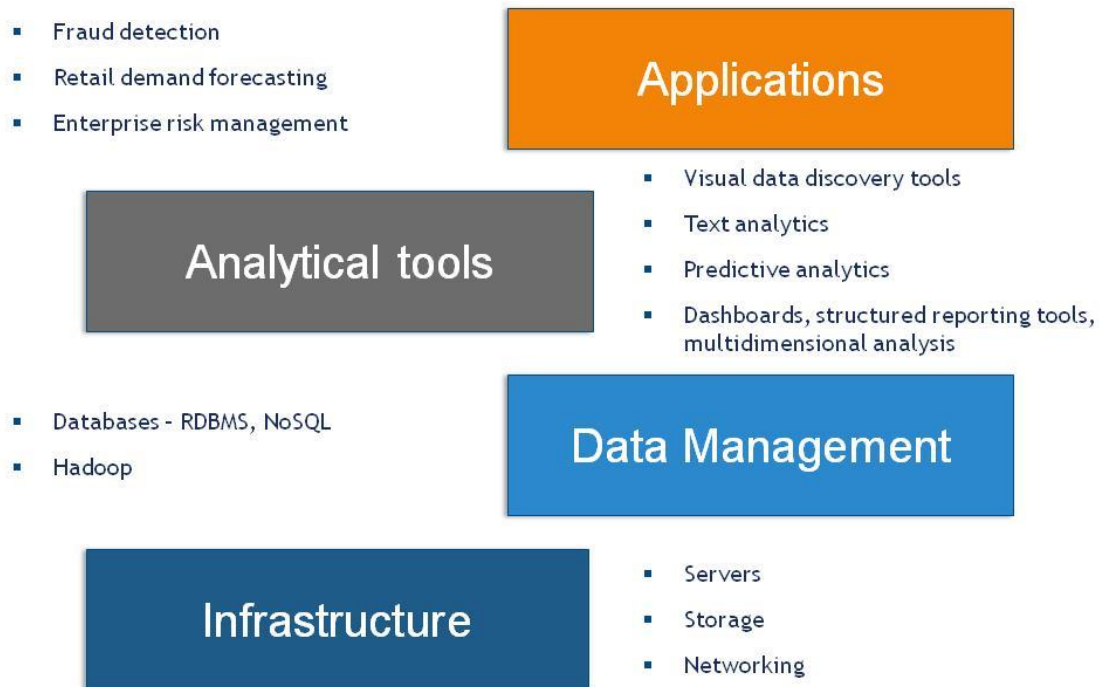
IDC divides the Big Data technology stack into four layers: infrastructure, data management, analytical tools and applications

- **Infrastructure.** This layer is about hardware; namely, servers, storage and networking.
- **Data management.** This layer covers software for databases and data stores such as relational database management systems (RDBMS), non-relational data stores like hierarchical database, graph databases, NoSQL databases and others.
- **Analytical tools.** This layer includes tools that are used to explore and analyze data, such as dashboards, visual data discovery tools, and enterprise reporting tools. It also consists of tools like text analytics and predictive analytics that extract particular data points and sometimes make extrapolations from them, for example when text analytics tools measure sentiment, and when predictive analytics tools give calculated scores like churn scores or up sell scores.
- **Applications.** This layer concerns applications that have been enhanced with intelligence from Big Data, such as fraud detection where patterns of fraudulent activity are matched to new transactions in order to predict fraud, retail demand forecasting where the application forecasts future demand based on previous demand and other information like weather, sporting events, and local conditions.

Figure 3 below shows the layers of the Big Data technology stack.

⁶ "Central Growth Scenario" estimates taken from Addressing Future Demand for High-Level ICT Skills, November 2013, Forfas

Figure 3: Big Data Technology Stack



Source: IDC 2014

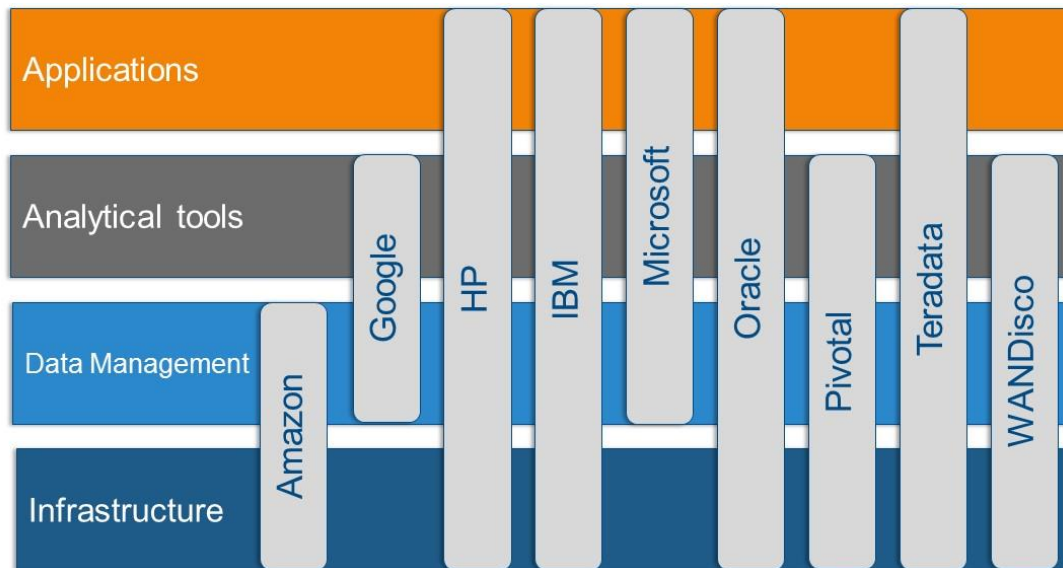
Leading Big Data Vendors

There are a wide range of solution providers working in the Big Data market, from longstanding technology providers offering full platforms, through open source specialists focusing on Hadoop, to application providers embedding advanced analytics. The charts below are not exhaustive but provide an overview of the main vendors by segment, and those who are present in Ireland.

Figure 4 below shows vendors in the infrastructure and data management technology markets.

Many of the vendors in these segments reach across all layers of the stack. In the lower layers of the stack there is a natural synergy between the technologies. For example it is natural for a vendor providing infrastructure to take advantage of performance optimization within the infrastructure to also provide data management capabilities. Likewise it makes sense for a vendor providing a data management layer to also provide the analytical tools with which to query the data.

Figure 4: Big Data Vendors - Infrastructure and Data Management

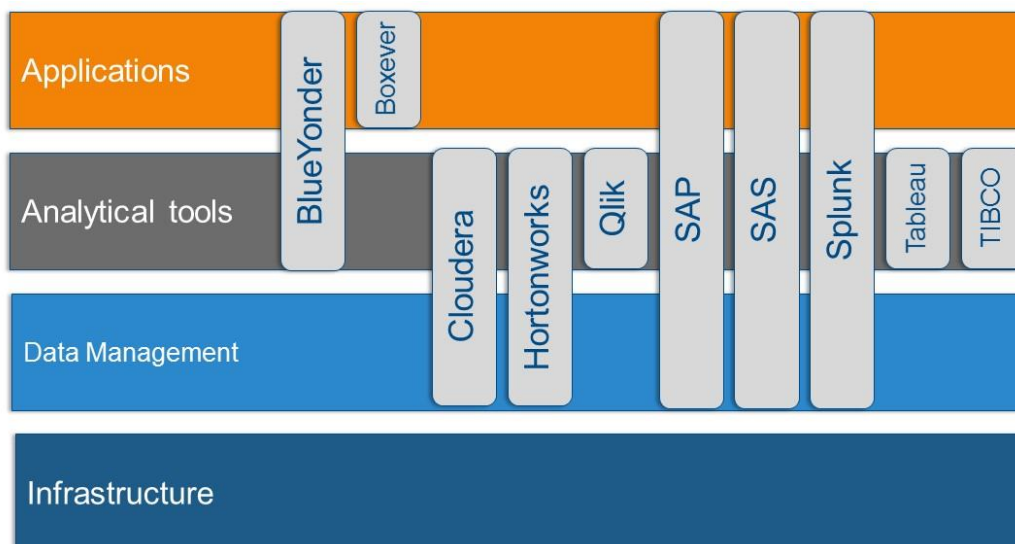


Source: IDC 2014

Figure 5 below shows vendors in the analytical tools and applications technology markets.

The analytical tools market has the highest number of pure players, with these vendors focusing on the ability to integrate a wide range of data sources in order to present the end-user with as rich a dataset as possible, and also on providing an easy-to-use interface for the user to explore and present the data. The applications market has relatively few pure-players but we believe this market is where the greatest variety and opportunity lies. Economies of scale and market presence are less important in the applications market than finding a lucrative niche where a specific business process, user population, or function requires specific information.

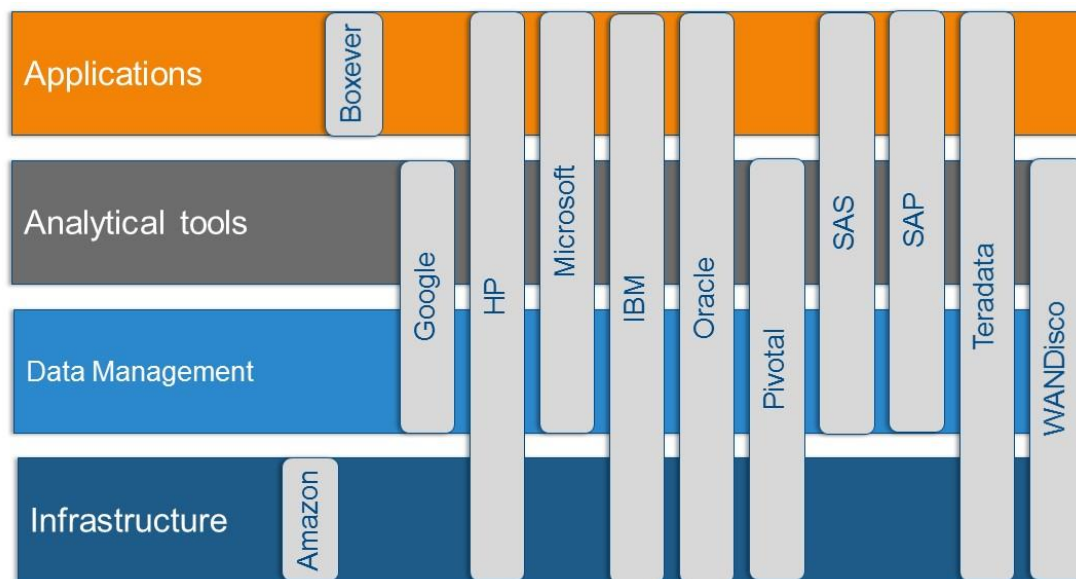
Figure 5: Big Data Vendors - Hadoop Pure-Plays, analytical tools and applications



Source: IDC 2014

In the lower levels of the technology stack, namely infrastructure, data management and, to an extent analytical tools, vendor scale and standardization gives large multinational corporations a huge advantage. Customers want to buy standard equipment from recognized brands, where there is likely to be an existing commercial relationship, and some level of existing trust in the vendor. However, in the application layer, this is less true. The rise of Big Data presents new underlying tools and technologies with which to build applications, makes data more accessible and easily loaded into these applications, and democratizes the use of advanced techniques such as predictive analytics, machine learning and semantic analysis. Therefore, we see the largest opportunity for new local Irish technology companies in the application layer as it is here where there is the potential for the creation of differentiated solutions tailored to the specific needs of a sector or specific business need.

Figure 6: Big Data Vendors - Present in Ireland



Source: IDC 2014

Some of the markets for these applications will be international in nature. For example, Boxever, an Irish travel technology specialist, has an office in Silicon Valley and sells very much internationally, focusing on large travel comparison platforms as its customers, with no geographical dimension to its business. Another market that is similar in nature is the market for telecom marketing platforms; these platforms are sold to telcos across the world, and telcos are accustomed to looking across the globe to find suppliers. Irish vendors should focus on finding niches in specific industries and avoid the temptation to restrict themselves to the Irish or even European regions.

4.4 Vertical Market Application of Big Data

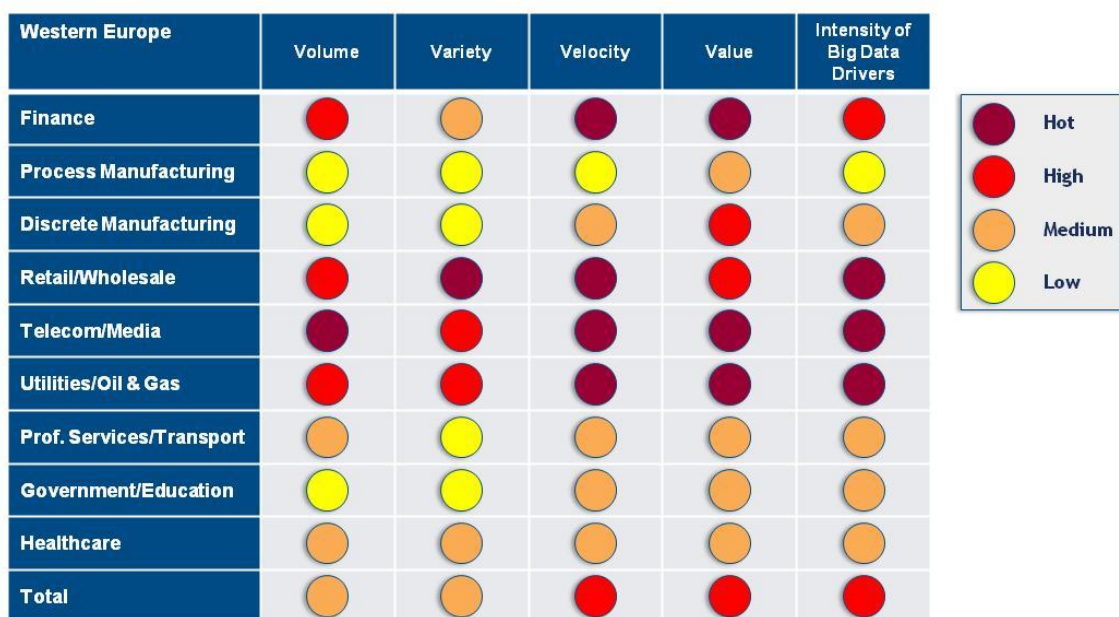
Big Data is broader than a set of technologies; it is a conceptual approach that focuses on providing information to support business decision-making, via the application of technology. How Big Data is applied in businesses varies from business to business and from sector to sector, because the needs of the decision-makers, the output format of the information, the input data, and the specific methodology for extracting business value all differ. The charts below illustrate for each of the core vertical markets how European business are and expect to deploy Big Data in their business to

deliver specific outcomes. This should not be seen as a definitive list, rather a set of indicators of how Big Data will be used in the different sectors. These indicators in turn give direction to the types of technical and commercial skills that need to be available in Ireland in order for businesses to execute on their Big Data strategies locally.

Assessment of the "4 Vs" of Big Data by Vertical Market

In 2013 IDC undertook a study⁷, interviewing over 1600 organisations across major Western European countries to understand their current and future plans for the adoption of Big Data in their business. In the study respondents were asked to rate their company's position with regard to the "4 Vs" of Big Data, discussed above. Figure 7 below shows the outcomes of this analysis by vertical with an additional measure combining the "4Vs" together.

Figure 7: Vertical Market Big Data "Heatmap"



Based on mean scores assigned by survey respondents

Source: IDC 2013

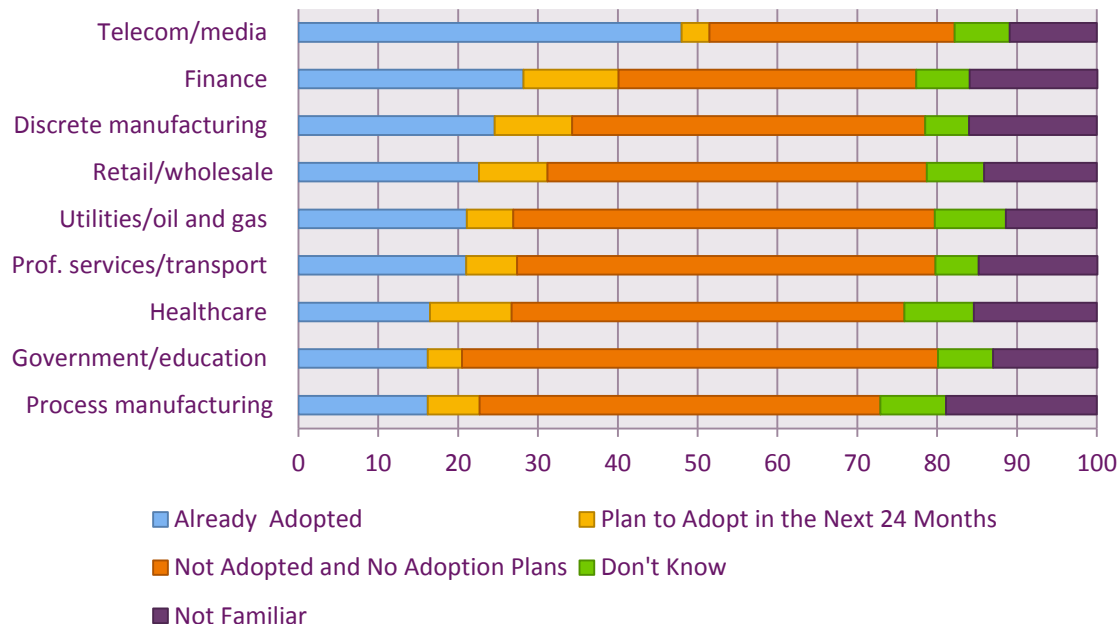
What is clear from the above heatmap is the strength of the drivers for use of Big Data in Retail/Wholesale, Telecom/Media and Utilities/Oil & Gas sectors. These sectors are all well represented in Ireland and as such they should be encouraged to be a core part of any Big Data initiatives being introduced. Of course it is reasonable to assume that these sectors will continue to be aggressive adopters of Big Data and therefore will need little encouragement through policy intervention. It is important though to ensure that the required skills to support the adoption of Big Data initiatives in these sectors are available.

⁷ Big Data Drivers, Barriers, and Key Use Cases in Western European Vertical Markets, IDC Jan 2014

Use cases for Big Data

Big Data is not a "thing" in its own right it is an approach and the application of technology to deliver an outcome. How Big Data is applied in businesses varies from business to business and from sector to sector. The chart below illustrates how current and near term plans for Big Data initiatives varies dramatically by vertical market.

Figure 8: Western Europe Big Data Activity by Vertical 2013



Source: IDC 2013

As the chart illustrates the telecommunications and Media sector is the most advanced when it comes to having already adopted Big Data with nearly 50% of respondents stating this to be the case. Finance is the next biggest current adopter and this sector is also the one that where there is the largest number of near term adoption plans in place, just ahead of Healthcare. Government and Education is where there is currently the lowest level of current or near term adoption with nearly 60% of respondents having awareness of Big Data but no plans and further 24% either Not Familiar with the concept or Don't Know what their plans might be. It may be that concerns about how the Public Sector is able to use Big Data are holding this sector back more than others.

For each of the above core vertical markets IDC have explored how the businesses are expecting to deploy Big Data in their business to deliver specific outcomes and we explore each sector in turn in Annex A of this report. This provides details on what each of these sectors is doing in the adoption of Big Data, how much each sector spends on IT and the number of enterprises in the sector. This information is provided in order to provide context to the ways in which Big Data initiatives can be adopted by different sectors of the economy and to help address questions that may arise regarding "what does Big Data mean for me?"

This should not be seen as a definitive list as there will be many other use cases not identified by the respondents but it does give a pointer as to how Big Data can be used in the different sectors and then this gives direction to the types of technical and commercial skills that need to be available in Ireland if businesses are to execute their Big Data strategies locally and in turn will help to formulate ideas relating to policy initiatives.

Many people seem to make the incorrect assumption that Big Data activities are in some way directly linked to the use of Public or Open Data. What is clear from our research into current and planned Big Data initiatives is that many of them require little or no data that is external to the organisation. This further helps to emphasise that the challenge many organisations face, and which is holding back their desire to embark upon Big Data initiatives is simply the ability to understand how and to undertake Big Data analytics within their business

Summary of Key Opportunities For Ireland in the Big Data Industry and Vertical Markets

As indicated above, we see the largest opportunity for new local Irish technology companies in the application layer as it is here where there is the potential for the creation of differentiated solutions tailored to the specific needs of a sector or specific business need.

Where then should Ireland focus its activities in developing a leading position in Big Data, recognising that much of the direct beneficial economic impact will be in the area of services, there being a direct link between the size of the services business and the number of people employed, rather than hardware and software? The services business has the benefit of delivering positive economic results far quicker than is the case for hardware and to a lesser extent software, where there is a longer lead time (especially if a production facility has to be built) between starting an initiative and having a finished product to take to market. Services businesses are also more readily able to address demands from overseas markets as well as the domestic market, delivering valuable foreign currencies into the economy.

Below we highlight those vertical markets where we see there is strong potential for Ireland to achieve the leading position it aspires to in the Big Data area.

- Investment in activities relating to Big Data in the Government and Healthcare sectors should be encouraged across the various funding agencies and Government Departments as they will not only deliver data driven benefits to the government and the wider population but also create new employment opportunities and act as Lighthouse projects for the whole Big Data initiative. These initiatives should be used as a way to allay fears about data privacy by showing data can be used in a positive and secure way, delivering real benefit to the country, the population as a whole and the individual.
- Ireland has already developed a high level of competence in the Oil and Gas industry, the work being done with Tullow Oil and Irish Centre for High-End Computing (ICHEC) being just one example and this should be capitalised on to encourage other firms in the sector to also look to Ireland for the required expertise when it comes to processing the incredibly large volumes of data that are associated with the exploration and production side of this sector. This is a sector that very much demonstrates that Big Data is not all about the use of Open Data since there is little or no third party data utilised by the sector when analysing potential oil exploration and production.
- The telecommunications and retail sectors are also early adopters of Big Data concepts and this early adoption will lead to a continued demand for skills as they become ever more ambitious about how they use data to differentiate themselves in highly competitive sectors and develop new products and services.
- It is to be expected that the Financial Services sector will increase the use of Big Data in both its development of new products and services for both its retail and commercial customers but also in its drive to make better and faster decisions about investments to give the institutions a competitive edge in the market. With the industry being a truly global one, there is a huge potential for Ireland to become a strong centre of expertise to service the specific needs of this sector.

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

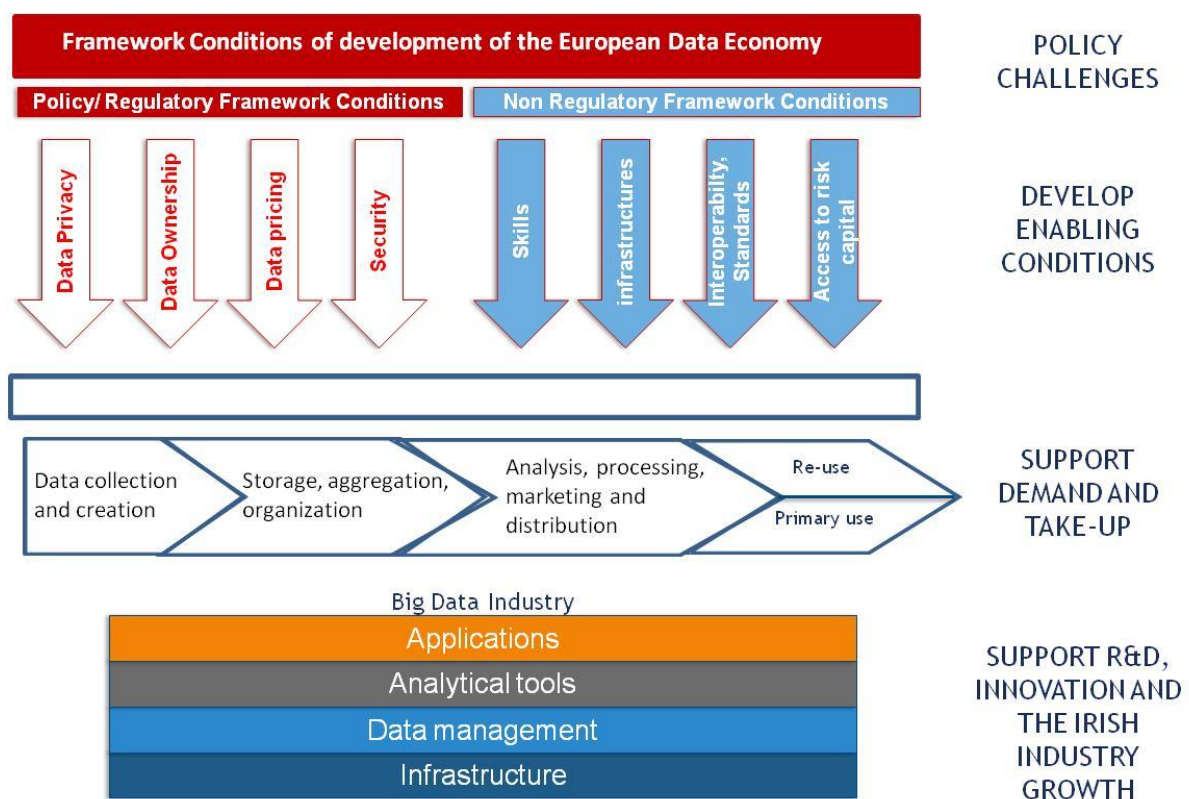
- Other industry sectors where Ireland has recognised levels of competence and where there is significant interest and potential for the adoption of Big Data solutions include Manufacturing, Pharmaceuticals and Tourism. In the area of manufacturing the increased use of sensors in the production process is leading to a dramatic increase in demands for data analytics. Likewise the complexity involved in the creation and ultimate market deployment of new drugs is stretching the data analytic capabilities of the pharmaceutical industry and High Performance Computing (HPC) solutions may be required to respond to their competitive challenges. A specific effort to modernise tourism through Big Data applications and services exploiting customer data and updating marketing techniques could have very positive results for Ireland's growth. In addition, Big Data does not require high capital investments and can be adopted also by small enterprises as those in the tourism sector.

5. Main Policy Challenges

5.1 Policy Challenges and the Data Value Chain

Harnessing Big Data as a source of economic growth requires the development of an innovative ecosystem sustaining the implementation of the data value chain. Figure 9 shows the main policy challenges to be met in order to support the development of the ecosystem, developed on the basis of the OECD view of data-driven innovation policies and IDC research.

Figure 9: Big Data Value Chain



Source: IDC 2014

The main areas of policy intervention are the following.

Develop favourable enabling conditions: The main role of policies is to remove barriers and obstacles to the market and create favourable conditions for market development and private initiative. Concerning the regulatory framework, the main issues concern balanced policies on data privacy, data ownership, data pricing and security management (given the new range of digital risks), in order to build trust and confidence in the data economy.

The non-regulatory framework challenges are equally if not more relevant. They include:

- Making sure that the supply of data skills responds to demand needs;

- Making sure that connectivity infrastructures provide sufficient speed and capacity for all of Ireland (particularly mobile broadband, a key support service for Big Data); this is one more reason to avoid digital divides;
- Promote open standard and interoperability to enable data sharing and data flows across the economy, avoiding potential lock-in or lock-out of users within proprietary systems;
- Making sure that Big Data innovative enterprises have sufficient access to risk capital (particularly start-ups and web entrepreneurs who may have difficulty accessing funding to develop their business ideas).

Support R&D, innovation and the Big Data Irish industry growth: these are supply-side policy challenges. Public intervention is needed to sustain sufficient investments in R&D and pre-commercial innovation, in connectivity infrastructures, to promote technology transfer so that innovation is brought to market by dynamic national enterprises, and to facilitate the growth of a native Big Data industry and private investment in the sector, for example in the development of data analytics and visualization tools for the main vertical markets.

Support demand and take-up: Promoting demand requires first of all building awareness of the potential opportunities generated by data-driven innovation. Policy should also help to accelerate the adoption of Big Data by the main user sectors, incentivising the organizational change required to extract and make available internal data sets, as well as maximise the opportunities of data sharing to extract value. The public sector should first of all innovate itself, leading by example and pursuing the opportunities of data-driven innovation enabled by Big Data.

These policy challenges are interrelated, responding to a holistic approach to the development of innovation. This is based on the concept that technology innovation produces new products, services and processes, but the socio-economic system needs to evolve too to be capable to adopt and exploit innovation successfully, reaping its benefits. Thus, successful innovation combine technology push (driven by technology innovation) and demand pull (that is new demand and adoption processes), which together stimulate cumulative processes of technology improvement and market growth.

5.2 Big Data Policy Challenges for Ireland

To gain Big Data leadership, Ireland must meet all these policy challenges, prioritizing the areas where the country can build on specific competitive advantages. Ireland is a small, open economy with already good potential positioning in the Big Data market, as shown by the growth of Big Data revenues estimated by IDC for the next years. Building on this and on main stakeholders' opinions on Irish strengths and weaknesses, we have identified a series of key policy challenges for Ireland which are presented in Table 7 below.

R&D and Supply

1. In the R&D and supply policy field, the main challenge for Ireland is to achieve a recognized global leadership in R&D on data analytics and privacy enhancing technologies, resulting in a competitive advantage at the technology frontier. Without sufficient R&D investments it would be difficult to trigger a successful technology transfer mechanism to the market.
2. This will lay the basis for the development of a competitive Irish Big Data industry able to launch on the market new apps, tools and data management services. An important key challenge is to stimulate the birth and growth of start-ups and SMEs developing data-based apps and tools for the domestic and global market.

3. A successful data industry requires insuring widespread high-speed Internet connectivity across the country, particularly mobile broadband, avoiding the risk of potential digital divides which may prevent take-up by some of the potential demand.
4. It is also important to develop data infrastructures and platforms (facilitating access to open and shared data sets) to enable Ireland to become a “data hub” in the EU for multinational companies.
5. Overall, the key challenge for Ireland is to support the existing and nascent data industries in their interaction with demand, by promoting a coherent demand-supply ecosystem. A very important component of this challenge is creating the condition to harness the collaboration between start-ups and small innovators and corporate players, making sure that the first have access to high profile users and the second have access to the necessary know how and entrepreneurship.

Demand

6. To concretely promote the demand for Big Data and analytics Ireland should put in place initiatives supporting data-driven entrepreneurship and organizational change by potential user organizations.
7. This means fostering the use of Big Data across all economy sectors, incentivising the extraction, availability and exploitation of rich data sets in order to extract their value added, promoting data sharing.
8. To achieve these goals, another relevant challenge is to promote awareness about Big Data value and benefits by citizens, enterprises and all potential users’ organizations.
9. Finally, Ireland should make sure to support the provision and use of open data and shared data sets, particularly by the public sector “leading by example”.

Enabling Conditions

The main challenge for the Irish government is to identify and remove all potential barriers to the market development. The Big Data market does not arise in a vacuum. There is already a complex regulatory framework overseeing data privacy and data protection, as well as competition regulation preventing abuse of market power and customer lock-in by proprietary technology solutions. However, Big Data technologies open new scenarios and create new risks.

More specifically:

10. Ireland faces the challenge of supporting the development of better data governance regimes to overcome barriers associated with data ownership and control, access, sharing and interoperability of data, balancing business and consumer interests. This concerns the new patterns of interaction between market actors and how these processes should be governed in order to respect the principles of fair competition, transparency and privacy protection.
11. Another key challenge is to build trust and confidence in the data economy, going beyond the simple promise to defend privacy rights, making clear to citizens and organizations that they can trust data management processes and can gain substantial benefits from them. This is clearly correlated with the development of fair and transparent data governance regimes and requires proactive awareness campaigns.
12. Assuring the supply and development of data skills and competences is a challenge well understood by the Irish government, but remains a critical requirement.
13. Promoting open data portals and open standards for data interoperability and access. Open data is one of the key component of the data economy. Promoting open data portals is one

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

of the most secure ways to circulate and provide access to a large amount of trusted data, independent of any individual supplier. Finally, interoperability is a necessary condition for sharing data sets, while open standards contribute to avoid risks of customers' lock-in, facilitate SME access and use of data sets, and help maximising data value added.

14. Ireland needs to promote a digital risk management culture to meet new security challenges. Cyber-attacks are accelerating and businesses need to keep pace expanding risk management practices to the new digital risks and threats. Policy can help by supporting businesses in the identification of new risks and promoting good practice guidelines.

Table 7: Main Policy Challenges for Ireland

R&D / SUPPLY SIDE CHALLENGES	DEMAND-SIDE CHALLENGES	ENABLING CONDITIONS
<p>1. R&D</p> <p>Achieve recognized global leadership in R&D on data analytics and privacy enhancing technologies</p>	<p>6. Data-Driven Entrepreneurship</p> <p>Encourage data-driven entrepreneurship and organizational change enabling data-related innovation adoption across the economy</p>	<p>10. Governance Frameworks</p> <p>Establish governance frameworks for data ownership and control, access, sharing and interoperability balancing business and consumers interests</p>
<p>2. Competitive Big Data industry</p> <p>Build a competitive Irish Big Data industry stimulating the creation of start-ups and spin-offs developing apps, tools and data management services</p>	<p>7. Data Supply Chains and Provision of Shared Data Sets</p> <p>Incentivize the development of data supply chains within enterprises and the provision of shared data-sets</p>	<p>11. Trust and Confidence</p> <p>Build trust and confidence in data privacy and protection in the new data-driven environment</p>
<p>3. High Speed Internet</p> <p>Ensure widespread high-speed Internet connectivity across the country, particularly mobile broadband</p>	<p>8. Awareness</p> <p>Promote awareness of Big Data potential value and benefits by citizens and enterprises</p>	<p>12. Skills</p> <p>Assure the supply and development of data analytic skills and competencies</p>
<p>4. Data Infrastructures and Platforms</p> <p>Develop data infrastructures and platforms in order to become the EU «data hub» for multinational companies</p>	<p>9. Open Data Sets</p> <p>Government agencies leading by example in use and provision of open data sets</p>	<p>13. Open Data Portals and Standards</p> <p>Promote open data portals and open standards for data interoperability and access</p>
<p>5. Collaboration Between Start-Ups and Corporates</p> <p>Develop a coherent demand-supply ecosystem, harness collaboration between start-ups and corporate players</p>		<p>14. Security and Risk Management</p> <p>Meet new security challenges and promote a digital risk management culture</p>

6. Analysis of Main Policies and Lessons for Ireland

This chapter reviews the main policy measures launched at the EU level and by main Member States to promote the Big Data market and the lessons learned for Ireland.

6.1 The Need for New Policies for Data-Driven Innovation

The policy challenges identified above are coherent with the OECD⁸ ongoing study on data-driven Innovation and the new policy requirements of the emerging data economy. The OECD shares the view that the data economy will bring considerable benefits in terms of productivity, new services and knowledge creation. Beyond the supply-demand dynamics analysis, similar to the one presented above, the OECD underlines the relevance of what it calls societal challenges, potentially the greater threats for the data economy. This analysis shows that data-driven innovation has multiple socio-economic impacts; Big Data policies cannot but have a much wider scope than simply promoting a new technology.

For example, multiple studies have indicated the need to balance the exploitation of data with privacy and personal data protection, suggesting that high-profile events of privacy breaches could stop or throw back the development of the Big Data market. The most recent report by the US Presidency on the topic recognizes the need to manage digital risks and build safeguards for citizens.⁹

The OECD outlines deeper challenges which concern the overall structure of the market. They include:

- **Risk of loss of autonomy and freedom for all:** including individual autonomy, equality and free speech, descending from mass surveillance and discrimination enabled by data analytics. A first taste of this phenomenon was the revelations by Edward Snowden of the massive collection of personal data by the US security agencies.
- **Market concentration and dominance:** potentially due to the "winner takes all" mechanisms of the data economy. This requires a revision of traditional market competition regulation as it becomes much more difficult to identify abuse of excessive market power - witness for example the current battle between Amazon and main publishers led by French Hachette, accusing the American e-commerce giant of unfair market practices.
- **Shift in power exacerbating existing inequalities:** this challenge mirrors the previous one, from the point of view of increasing concentration and greater information asymmetry, which may favour organizations in the interaction with individuals, government with citizens, data-businesses versus traditional businesses.
- **Structural change in the labour market:** while the data economy is expected to generate new jobs within supplier and user companies, it is likely that data analytics will contribute to the automation of knowledge-intensive and intelligence-based tasks ("decision automation" as defined by the OECD) with the potential to eliminate or reduce jobs. This is one of the

⁸ OECD Data-driven Innovation for Growth and Well-being, Interim Synthesis Report, October 2014

⁹ White House, Executive Office of the President: Big Data and Privacy Report, May 2014

http://www.whitehouse.gov/sites/default/files/docs/big_data_privacy_report_5.1.14_final_print.pdf

factors considered in the famous study by two Oxford researchers, concluding that almost half of existing white-collar jobs will be automated in the near future¹⁰.

- **Need to change traditional security approach:** Last but not least, data-driven innovation requires an environment where security does not prevent sharing massive volumes of data, and a new digital risk-based approach involving all stakeholders (as simple technical fix-it solutions will not be sufficient).

This analysis confirms the need for the Irish government to promote a holistic and coordinated policy approach for Big Data, as the only way to become a leader in the Big Data economy.

Many of these challenges cannot be faced by national governments alone, and must be dealt with at the EU level. However, a clear understanding of the main challenges can help the Irish government to play a leading role in the international negotiations on these issues.

6.2 EU Data Policy

The European Commission has recognized the relevance of the emerging data economy and is fully committed to promote the development of the EU industry and EU ecosystem in this field. The main EU policy initiatives are summarised in the table below. Proactive policies on Open Data, the re-use of Public Sector Information and the revision of the Data Protection Directive were implemented in the last years, within the context of the Digital Agenda for Europe (DAE) the EC framework policy on ICTs. However in 2014 there was a substantial acceleration in data policy initiatives, reflected by the EC Communication "Towards a thriving data-driven economy" published in July 2014.

The Communication presents an Action plan for this objective and was followed by the formal launch of the Public Private Partnership on Big Data Value (October 2014), promoted by the Big Data Value association which includes major industry actors such as ATOS, Nokia Solutions and Networks, Orange, SAP, SIEMENS, and research bodies such as Fraunhofer and the German Research Centre for Artificial Intelligence. The PPP should activate investments for 2.5 B€, of which 500 M€ by the EC and the other contributed by the industry partners. Their main focus will be to bridge the gap between research and market, by facing the main data market innovation challenges. A key aspect of this action will be the development of European innovation spaces that will offer secure environments for experimenting with both private and open data. These will also act as business incubators and hubs for the development of skills and best practices.

Table 8: Main EU Policy Initiatives on Big Data - updated at 31 October 2014

Policy	Source and date	Useful links
European contractual Public Private Partnership (PPP) on Big Data Value	MoU signed on 13 October 2014	http://www.bigdatavalue.eu/

¹⁰ Oxford Martin School, Carl Benedikt Frey and Michael A. Osborne: "The future of employment: how susceptible are jobs to computerization?" September 17, 2013

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

Policy	Source and date	Useful links
EC Communication: "Towards a thriving data-driven economy" accompanied by Commission Staff Working Document	Brussels, 2.7.2014 COM(2014) 442 final	https://ec.europa.eu/digital-agenda/en/news/communication-data-driven-economy
Horizon 2020 Research Programme - Main areas related to data: ICT in Excellent Science/ e-Infrastructures: Big Data Infrastructures ICT in 'Leadership in Enabling and Industrial Technologies' / Content technologies and Information Management / Big Data innovation and take-up, Big Data research	Work Programme 2014-2015	https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/ICT%20in%20H2020%20WP2014-15_0.pdf
Strategic Policy Forum on Digital Entrepreneurship and Digital Entrepreneurship Monitor	February 2014	http://ec.europa.eu/enterprise/sectors/ict/digital-entrepreneurship/strategic-policy-forum/index_en.htm http://ec.europa.eu/enterprise/dem/monitor
Revised PSI Directive - on re-use of Public Sector Information	Directive 2013/37/EU of 26 June 2013	http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:175:0001:0008:EN:PDF
EU implementation of Open Data Charter by G8	Entered into effect in June 2013	http://ec.europa.eu/digital-agenda/en/news/eu-implementation-g8-open-data-charter
DAE - Digital Agenda for Europe - Pillar I: Digital Single Market - Action 3: Open up Public data resources; Action 12: Review data protection rules; Action 107: Proposals to strengthen the data industry in Europe	Brussels, 18.12.2012 COM(2012) 784 final	http://ec.europa.eu/digital-agenda/en/our-goals http://ec.europa.eu/digital-agenda/en/our-goals/pillar-i-digital-single-market#Our%20Actions
EC Communication: "Open data - An engine for innovation, growth and transparent governance"	Brussels, 12.12.2011 COM(2011) 882 final	http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0882:FIN:EN:PDF

Source: IDC elaboration on EC data

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

Another major focus of the EC policy for the data market is the EC Framework Programme on research and innovation Horizon 2020 (H2020), which will coordinate EC investments until 2020. Data-related initiatives are present in all the main components of the H2020 ICT Programme, including investment in Big Data Infrastructures in the ICT in Excellent Science component and in data research and data innovation in the LEIT (Leadership in Enabling and Industrial Technologies') component. Overall, Big Data projects are getting 89 M€ in 2014 and 2015 from the H2020 programme. They include research and innovation on business intelligence, decision support processes and systems supporting SMEs and web entrepreneurs. H2020 is also setting up an 'open data incubator' next year to help SMEs develop their prototype data applications. The incubator, linked to local ones across Europe, will also help the companies set up supply chains for products and services based on open data resources and attract others to contribute some of their own data assets for experimentation.

Finally, DG Enterprise pays close attention to Big Data business opportunities in its Digital Entrepreneurship Programme, which includes a Digital Entrepreneurship Monitor and is led by a Strategic Policy Forum by experts, and a Member States Board. This ensures that EC policies in this field are coordinated with those at the national level, particularly concerning SMEs.

A more detailed view of the main initiatives activated by the European Commission is presented in the table below.

Table 9: EC Communication Action Plan and Big Data PPP - Main Initiatives

Main goal	Initiatives	Description
R&D	Contractual Public-Private Partnership (cPPP) on data, named European Partnership for Big Data Value (EP-Big DataV)	<p>EP-Big DataV sets out the Strategic Research and Innovation Agenda (SRIA) and its main objective is to deliver the SRIA within the Horizon 2020. The specific objectives/outcomes should be:</p> <p>European Innovation Spaces and Environment (EIS/E) as hubs of innovation</p> <p>Improve availability, integrity, confidentiality of the data sources</p> <p>Testing and benchmarking of technologies, applications, business models</p> <p>Development of Big Data technologies, tools and data-driven applications; inputs provision for standardization and regulation</p> <p>Development of skills and sharing of best practices</p> <p>EIS/E will be the playground to test business models and emerging ecosystems</p> <p>Test social impacts of new technologies</p>
	PRACE (Partnership for Advanced Computing in Europe)	Will tackle scientific challenges through the existing cPPP on HPC. Support to next generation of HPC technologies as enablers for big data applications

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

Innovation	Digital entrepreneurship and open data incubator	The EP-Big DataV is supporting Digital Entrepreneurship and within H2020 an open data incubator will help SMEs set up supply chains based on data
	Identification of the sectoral priorities for innovation	The Commission will invite stakeholders and research communities to propose initiatives that should attract private and public funding
	H2020 supports setting-up and networking of competence centres	The objective is to support SMEs in developing and accessing data technology and services
	IoT projects	Large number of projects will be funded to tackle questions of quality and interoperability of data gathered through smart connected objects
Take up and demand support	Data market monitoring tool	The Commission is setting a data market monitoring tool to measure the size and trends of the European data market
	H2020 addresses descriptive and predictive data analytics, data visualisation, artificial intelligence and decision-making software	To support innovation in business intelligence, decision processes, and systems for SMEs and web entrepreneurs
Framework conditions	Developing skills	The Commission will design a European network of centers of competence to increase the number of skilled data professionals, in line with the Grand Coalition.
	Fostering open data	In order to facilitate the implementation of the EU open data policy, the EC is preparing guidelines on: standard licenses, datasets, charging for the re-use of documents.
	Open access to H2020 and other specific initiatives	Further opening up data access and re-use covering sector-specific data
	ISA programme	ISA programme facilitates the use of data standards and interoperability for national administrations
	European Cloud Computing Strategy on transparency and standards	Facilitates a more rapid adoption of trusted cloud computing that will boost the data-driven economy
	Actions under H2020	Will address the use and configuration of cloud solutions for data analytics and advanced infrastructures and services

	PPP on 5G encourages private investments in BB infrastructures	Such infrastructures will support the capacity to handle large amounts of data
Regulation	Commission data protection reform	Will provide a regulatory environment for the development of data goods and services
	Data mining	The Commission is investigating ways in which data-driven innovation based on data-mining, including text-mining, might be enhanced, including in relation to the relevant copyright aspects.
	Security	The Commission will explore the landscape of security risks relating to big data and will propose risk management and mitigation measures
	Transfer of data	Data location requirements limit the cross-border flow of information and form a barrier to a single market for cloud computing and big data. The Commission will study such barriers and will consider future policy actions.

Source: IDC elaboration on EC data, 2014

6.3 Major National Policies

Ireland is not alone in seeking to maximise the potential and the positive impact on their economy that Big Data presents, from both a demand and supply perspective. Below we highlight some of the initiatives that we consider as being of particular interest to the DJEI and their intentions regarding Big Data.

France

In July 2014 adopted a specific plan focused on Big Data as one of the 34 initiatives that are part of the Program "Nouvelle France Industrielle"¹¹. The plan embraces fourteen actions that address supply, demand, R&D and regulation.

Specific actions embodied in the plan include the following:

- The creation of a "Big Data personal trust space" developed by the Fondation Internet Nouvelle Génération (next-generation Internet foundation), in partnership with several private-sector businesses. The creation of the "space" is intended to foster the development of new services by combining personal data, although under the control of each individual to whom the data relates
- Training data scientists
- The development of new services for job-seekers.

¹¹ <http://proxy-pubminefi.diffusion.finances.gouv.fr/pub/document/18/17721.pdf#page=9>

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

- Collaborating with CNIL, the French data-protection agency, on modernising the working of the French Data-Protection Act, gearing it to industrial-process certification in the context of complete ecosystems (e.g. the "networked car");
- Support for a Big Data accelerator in Paris; an investment of €300 million from private and public funds to support 100 start-ups to emerge under the "French Tech" initiative; public funding of €11.5 Million for 12 Big Data projects;
- Accelerate the adoption of Big Data in a number of sectors, including tourism, transport, energy and insurance

The expected impact of the initiative is to create a Big Data market with a value close to €9 billion by 2020 along with a workforce of over 130,000 jobs, made up of both existing "data" workers and the creation of new jobs.

R&D Tax Incentives

R&D tax incentives have an important role to play to support start-ups and innovative enterprises for the development and the adoption of Big Data-related innovation. France offers several incentives aimed at encouraging the growth of R&D-intensive businesses including innovation grants and acceleration of depreciation deductions for fixed assets used in R&D activities.

One new type of incentive could be of interest for Ireland. Starting January 1, 2013, France implemented a new tax incentive called "Innovation Tax Credit" for downstream activities, such as expenditures for new prototypes or pilot assets. This incentive is only available to SMEs (companies with less than 250 employees and sales less than €50M). The tax credit rate is 20% and the amount of qualifying expenses is capped at €400K¹². Revenues derived from licensing or sale of patent or patentable technology are taxed at 15% reduced rate, with the requirement that the technology must have been owned by the French company for at least 2 years and the sale of the technology to related parties are excluded from the benefit of the 15% rate. Moreover, for the French licensee, the royalty fee is deductible at the 33.33% rate.

Germany

Big Data faces its own specific challenges in Germany as a result of the local interpretation of data privacy legislation making an Open Data strategy and the sharing of data much more problematic. It has also created an environment that does not encourage non-German companies to actively pursue a Big Data initiative there. That said Germany is not standing by whilst others build their competencies and skills. Specific initiatives that have been launched in Germany include:

- Since 2013, the Federal Ministry of Education and Research (BMBF) has included Big Data management and analytics research in the 2020 research programme *IKT 2020 - Forschung für Innovationen*¹³. BMBF will spend €20 million to support Big Data research in the life sciences, geosciences, and industrial sectors.
- In April 2014, BMBF¹⁴ announced the establishment of two Big Data competency centres (the Berlin Big Data Centre and the Competence Centre for Scalable Data Services and Solutions in Dresden).
- In January 2014, the German Government announced the creation of a Smart Data Innovation Lab operated by the Karlsruhe Institute of Technology, to carry out advanced research and experimentation of high speed data projects, with the collaboration of Microsoft, SAP, Software AG, Hitachi Data Systems, Bayer, Bosch, Energy Baden-Württemberg (EnBW),

¹² Source: Deloitte, 2014 Global Survey of R&D Tax Incentives.

<https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Tax/dttl-tax-global-rd-survey-aug-2014.pdf>

¹³ <http://www.bmbf.de/foerderungen/25038.php>

¹⁴ <http://www.bigdatavalue.eu/index.php/news/54-germany>

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

Forschungszentrum Jülich, Fraunhofer, German Research Centre for Artificial Intelligence (DFKI), Siemens. The application areas to be targeted include Industry 4.0 (the German manufacturing industry innovation initiative), Energy, Smart Cities and Medicine.

Italy

- Italy does not have Big Data policies, but some R&D tax incentive policies may be of interest for Ireland. Specifically, Italy launched in 2013 a policy of tax relief for investments in “R&D Intensive Start-up companies” (IST): ISTs are companies with the main goal of developing and producing innovative and technologically advanced products or services. For fiscal years 2013 through 2016, corporations investing in an IST can have an immediate deduction equal to 20% of the invested amount (the maximum eligible investment is equal to €1.8M per year). Individuals investing in an IST have a 19% tax credit for 2013, 2014, 2015 and 2016 (the annual maximum investments is €500K per year).
- In addition, there is a 35% tax credit for hiring researchers (for fiscal years 2012 forward) for total labour cost incurred by companies hiring qualifying researchers. Eligible employees are those with a university degree or a Ph.D. (researchers without a Ph.D. must be employed only in R&D activities). Researchers must be employed by the company for at least 3 years (the limit is 2 years for Small Medium Enterprises) and the credit is subject to a cap of €200K per company annually.

Netherlands

The Dutch government is fostering the development of a Big Data industry through initiatives such as Doorbraakproject “Big Data”¹⁵ a project developed to help investors and entrepreneurs share knowledge and insights with the ultimate aim of generating new business opportunities for Big Data.

In the Netherlands the telecom, hospitality and financial industry sectors are currently the forerunners in adoption. There are successful start-ups¹⁶, eg Synerscope for Finance, but there have also been failed projects, such as those from IGN, where the bank proposed to sell its customer data to advertisers based in the customer's transaction history resulting in the not unexpected backlash from the customers and Equens, who believed that by aggregating data up to the post code level meant that it was sufficiently anonymous only to find that they were in breach of the Dutch Data Privacy legislation. Indeed the very act of aggregating the data was deemed, under the law to be data processing and as such an action that was covered by the legislation.

UK

It is perhaps not too surprising, given that the UK is often seen as being the bridge between the United States and the rest of Europe when it comes to the adoption of new trends in technology (Outsourcing and Cloud Computing being just two such examples where adoption in the UK has led the rest of Europe), that Big Data is seen as being a major opportunity for all of the players¹⁷.

The Centre for Economics and Business Research estimates that the big data marketplace¹⁸ could benefit the UK economy by £216 billion and create 58,000 new jobs in the UK before 2017. Furthermore, a recent report from Deloitte estimates that the direct value of Public Sector information alone to the UK economy is around £1.8 billion per year, with wider social and economic benefits bringing this up to around £6.8 billion.

¹⁵ <http://www.doorbraakmetbigdata.nl/over>

¹⁶ Source: IDC report “Western Europe Big Data Technology and Services 2011–2013 Market Size and 2014–2018 Forecast by Country and Segment”, August 2014

¹⁷ <http://www.rcuk.ac.uk/research/infrastructure/big-data/>

¹⁸ “Data equity: Unlocking the value of big data, by CEBR
<http://www.sas.com/offices/europe/uk/downloads/data-equity-cebr.pdf>

Research by the National Endowment for Science, Technology and the Arts (Nesta)¹⁹ also shows that UK data-driven firms are 40% more likely to report launching products and services ahead of their non-data savvy competitors.

Against this positive background the UK Government has made funds available to help promote research into and adoption of Big Data solutions. Notable examples of this activity include

- The launch of the Alan Turing Institute for Data Science²⁰, announced in March 2014, with £42 million government investment over 5 years that will strengthen the UK's aims to be a world leader in the analysis and application of Big Data.
- The creation of the Big Data Health Research Centre at Oxford²¹ with public-private funding (UK Research Partnership Fund): £10 million by Gov, £20 million by philanthropist Li Ka Shing (2013)

6.4 Lessons Learned for Ireland

Competitive strategy

France, Germany, UK all aim for leadership in this area. This creates tough competition for Ireland as countries bid to encourage both external research and development funds for academic institutes and also the attraction of companies to establish their Big Data skills and service delivery centres in the country. What Ireland cannot change is that these three countries present a much larger domestic market opportunity for Big Data than the Irish one. This has clear consequences for Ireland's policy choices.

Lesson learned: Identify and leverage specific competitive advantages

Ireland should leverage specific competitive advantages and differentiate its positioning from that of the large EU countries. Collaboration with the EU PPP on Big Data is a strong positive, but again is not unique. Focusing on a number of specific areas to establish true global expertise is likely to achieve a more positive outcome than being a generalist.

Investment strategy

Looking at the EU and national initiatives, we notice that their main focus is on R&D investments and data skills development. They are complemented by measures supporting the creation of new start-ups, both for the delivery of Big Data tools and services but also to develop new business that can only exist because of Big Data. The investments planned are sizable and cover a period of several years, showing a strong political commitment.

Lesson learned: Pursue a multi-annual investment strategy

Successful R&D investments require strong political commitment, multi-annual resources engagement and a complementary policy of development of the necessary data skills.

The French Big Data Plan

The French Big Data plan is more ambitious than the other countries' plans, covering the whole new data value chain, within the framework of a "New Industrial France" policy strategy covering

¹⁹ <http://www.nesta.org.uk/blog/inside-datavores-how-data-driven-businesses-are-raising-productivity-and-increasing-profits>

²⁰ <http://www.theguardian.com/science/2014/dec/04/alan-turing-institute-big-data-knowledge-quarter-london>

²¹ <http://www.ox.ac.uk/news/2013-05-03-prime-minister-joins-sir-ka-shing-li-launch-%C2%A390m-initiative-big-data-and-drug>

34 innovation initiatives. This is coherent with the high level of investment and public drive of the French R&D innovation policy. The level of investments is also quite high.

Lesson Learned: Watch closely the French Big Data Plan, but do not try to imitate it.

Ireland should follow carefully the evolution and implementation of France's strategy. The French plan is characteristic of that country powerful and complex machine of public policy intervention (with all its pros and cons). The Irish government approach is very different, and the scale of investments is likely to be unaffordable to Ireland. However, the French policy strategy covers all the main policy challenges and it can provide useful suggestions and inspiration to pick up ideas and avoid implementation risks.

Digital Risk Management

Big Data is not some magic bullet that guarantees strong economic growth. The failures of the IGN and Equens Dutch start-ups in The Netherlands are just two examples of how things can go wrong. Consumers are naturally (and wisely) wary of the ways in which their personal data might be used. Current data privacy legislation is often poorly written and ambiguous. Legislation that both encourages the development of a Big Data industry and also protects the individual who is the subject of the individual data items needs to be clear and easily understood by all parties. Big Data is not just about the use of third party data, a lot of activity relates to companies using data they have collected about their own customers and business environments and this also needs to be protected by legislation.

Lesson learned: keep a close watch on data digital risk management.

Ireland needs to keep a close watch on the potential digital risks as these are universally underestimated. Data privacy legislation needs to be written to reflect the issues, opportunities and challenges of the Big Data age.

Comparing Investment Plans

As the Table 10 below show Ireland is neither late nor underfunding its investments in Big Data. However comparison with other countries requires a degree of caution because the nature and intent of the investments are different.

Lesson learned: Irish investments are on a par with other EU countries

Building a Big Data economy will require continued investment. However it is important that the investment plans have clear and measurable outcomes associated with them so that they stand up to public scrutiny.

Table 10: Investment Funding for Big Data Initiatives in Some European Countries, 2014

INVESTMENTS		€m
France	Incubator	300.0
	12 projects	11.5
Germany	IKT Programme	20.0
Ireland	Insight	88.0
	CeADAR	1.0
UK	Turing Data Science centre	52.5
	Oxford Health R&D centre	37.5

Source: IDC elaboration on national sources, 2014

7. Gap Analysis of existing Policies and Initiatives in Ireland

This chapter provides a systematic review of the current Irish Big Data policies and initiatives, their current progress and to what extent they cover the main policy challenges identified above. The result is a gap analysis highlighting the policy areas where further action is needed in order to develop successfully the Big Data market and industry. This will lead to the development of policy recommendations.

Many of the policy measures identified were initiated or progressed by the Big Data Disruptive reform in 2013 and 2014, but the scope of analysis was extended to the main entrepreneurship and innovation policies relevant for Big Data, as well as the regulation reforms for data privacy and protection.

The assessment of current progress was based on the documentation provided by DJEI (such as progress reports), desk research of public sources and opinions collected through the stakeholder interviews. The progress information is updated to October 2014.

The gap analysis is based on our expert assessment, drawing conclusions from the review of current policies.

The results of the gap analysis are summarised as follows:

- Policy challenges well covered by current measures and with ongoing progress are defined as ON TRACK;
- Policy challenges partially covered by some initiatives are defined as SOME PROGRESS;
- Policy challenges currently not addressed by policy initiatives are identified as NO ACTION FOUND;
- Policy challenges which appear not to be addressed by any policy measure, but on which we were unable to cover all possible sources of information, are defined as NO EVIDENCE.

For each policy challenge we provide our assessment of progress, the assessment rationale and the supporting evidence.

This assessment is based on best effort and we are confident that the main conclusions are reliable. However, given the breadth and multidisciplinary nature of the policies reviewed, we may have missed specific developments or very recent actions.

The policy review is structured in the main policy areas described above. The policy initiatives are numbered corresponding with the list of policy challenges for Ireland (Table 7).

7.1 R&D and Innovation Policy Actions

Policy challenge	Number	Status
Achieve recognized global leadership in R&D in Big Data	1	ON TRACK

Assessment Rationale

To achieve a leadership position in R&D and innovation requires an environment that encourages the core activities through the provision of facilities and skills and recognises that not all activities will result in successful outcomes and those that do may not see a financial payback for quite some time. In itself R&D is not a function of a government, however the government can help to encourage R&D through funding for facilities, encouraging research facilities to embark on certain strategies and provide attractive fiscal regimes for businesses to focus their R&D efforts in the country. In assessing the Irish position with regard to R&D for Big Data we looked for clear evidence that there was clear policy to fund and support R&D activities in both the academic environment and also for commercial companies undertaking R&D in Ireland.

Overall, the R&D and innovation policy has been launched and is progressing in order to develop excellence research centres. This is a fundamental starting point. It is too early to say if this will achieve global leadership for Ireland in R&D, but if investments continue and the Insight and CeADAR centers continue making progress (also winning key EU funding), the prospects are good.

Type of actions

We found a number of actions addressed to develop technology excellence, including, for Big Data and Data Analytics the following ones.

- Supporting the further scaling-up of the INSIGHT Research Centre and of the CeADAR Technology Centre, including recruiting staff and looking for funding from non-Exchequer sources;
- Continuation of funding of R&D by all relevant research funders, in partnership with the enterprise sector, with a specific focus on “Data Analytics, Management, Security and Privacy”

Progress so far

- Both INSIGHT and CeADAR centres have been funded and are pursuing the established objectives.
- In collaboration with Enterprise Ireland and IDA Ireland, the CeADAR Centre has doubled its industry membership base (3D Progress report).
- The Insight Centre is a founding partner of the Big Data Value Association (Big DataVA) leading the EU PPP. Intel Research and Innovation Ireland are also founding members of the Big DataVA. The DERI group (which are part of the Insight Centre) co-ordinated the FP7 BIG project which has laid the foundations for the Big Data PPP.
- There was a successful participation to H2020 2014 call on Big Data: 3 out of 10 projects funded were coordinated by Ireland partners and they also participated in 1 more. Irish participation included academics and 5 separate SMEs. Negotiations are still ongoing, but funding share should be €3.5 million from an overall budget of €50.
- A new offering on supporting process and organisational innovation is to be made available through Enterprise Ireland in 2015. Data Analytics has been featuring in this field, and this new offering will thus provide further support for projects involving Big Data innovation. This grant scheme will in particular incentivise SMEs, although support will also be available to multinational companies under the condition that they are collaborating with an SME on the grant-aided activity.

7.2 Supply-side Actions

Policy challenge	Number	Status
Build a competitive Big Data industry	2	SOME PROGRESS

Assessment Rationale

Building a competitive Big Data industry requires the availability of resources, infrastructure and skills to support the industry and the demands of its participants. It also requires the confidence from the parties involved that the ideas as to how to use data can be turned into reality and thus the investment proposed is worthwhile. To this end government is an excellent environment in which to establish "lighthouse" projects which show that all the pieces of the jigsaw are in place for others to invest in the concept. This part of the study was looking for evidence regarding the establishment and progress of such "lighthouse" projects.

The Action Plan for Jobs 2014 includes only one action specifically addressed to develop specific offerings for the Big Data market, through pilot projects in two main vertical markets. However, there are innovation policies and entrepreneurship policies promoting start-ups and innovative SMEs, measures that are not focused on Big Data but can still contribute indirectly to the development of the Irish industry in this field.

Type of actions

More specifically:

- The 2014 Action Plan for jobs requested the Taskforce on Big Data to monitor the implementation of pilot initiatives whereby data analytics can be applied to address specific actions delivering economic impact and/or improved public services. These pilot projects were addressed to develop big data solutions, therefore we classified them as supply-side rather than take-up support.

Progress so far

- The Big Data Taskforce defined the criteria of pilot identification, screened a high number of potential projects and has selected 2 pilots, on big data in agriculture and in policy making for labour legislation.

Other Initiatives

- The Entrepreneurship Disruptive Reform includes several initiatives supporting start-ups and innovative SMEs, covering all technology innovation not only Big Data.
- The Winning Abroad policy managed by IDA is focused on attracting multinationals and also innovative start-ups, who could very well be in the field of Big Data.
- The National Health Innovation Hub was re-launched in 2014 with the goal to enable Irish SMEs to develop innovative e-Health products and services for the national healthcare system. Again, this is not addressed specifically to Big Data.

Policy challenge	Number	Status
Develop High speed Internet connectivity	3	SOME PROGRESS

Assessment Rationale

In the new "data enabled" world the collection and transmission of large quantities of data is key. This requires the establishment of high speed internet networks, fixed and mobile, throughout the country. It is not acceptable that parts of the economy are left out of the ability to participate purely because they do not have the network access required (and enjoyed by other participants located in another part of the country).

The development of broadband Internet connectivity is on track according to the National Plan for Broadband, even though, according to the latest data by the DAE (Digital Agenda for Europe) scoreboard, the deployment of very high speed networks (30 Megabit and above, 4G for mobile broadband, and NGA - Next generation access for fixed broadband) is slightly lower for Ireland than the EU average.

Type of actions

In October 2014 the Minister for Communications, Energy and Natural Resources declared that commercial investments are on track to respect the targets of the National Broadband Plan and that further actions are foreseen for broadband development in rural areas, in order to prevent the digital divide. A 3 years programme concluded in 2014 aimed at connecting all secondary schools with 100Mbps connections.

Progress so far

Fixed broadband coverage is quite advanced, in fact, according to the DAE scoreboard in January 2014 it was 96% overall, and 93% in rural areas, with a very small gap. The penetration of mobile broadband was at 67.7%, higher than the EU average, with Ireland ranked number 9 in the EU in terms of penetration.

Policy challenge	Number	Status
Develop data infrastructures and platforms to become the EU "data hub" for multinational companies	4	NO ACTION FOUND
Develop a coherent supply-demand ecosystem	5	

Assessment Rationale

The Supply-Side actions relate to ensuring that within the economy there are all the pieces in place to ensure that any organisation looking to embark on a Big Data journey are not constrained to do so because of the lack of skills, resources or infrastructure. In the assessment we were looking for actions that ensured there were no obstacles to an organisation wishing to undertake a Big Data initiative.

These two policy challenges are closely correlated, so they are both included here.

The first one concerns the development of proactive policies with the specific focus to develop data infrastructures and platforms in Ireland offering storage and computing capacity, hosting and access to Big Data sets, such as marketplaces. These infrastructures should serve both the Irish and

international market. Microsoft Azure Marketplace and Amazon Elastic Mapreduce for example offer some of these services through cloud computing. Ireland does have the beginnings of such an infrastructure, for example the ICHEC centre and Insight/CeADAR centres provide some of these facilities. A targeted policy would require an assessment of the type of infrastructure potentially needed, of the elements already present in Ireland, of the potential investments required with a business plan and ROI estimate. Finally this policy should assess the potential impacts on increasing Ireland's competitiveness and attractiveness for foreign investment. There does not seem to be currently such a policy.

The second policy challenge would require Ireland to support the existing and nascent data industries in their interaction with demand, by promoting a coherent demand-supply ecosystem. Present Irish policies are focused on R&D and skills and do not take much into account the interaction between supply and demand. This may include for example developing and leveraging the data infrastructure and creating the conditions for and supporting the interaction between small innovative enterprises and large potential users. As recognized in our recommendations in the next chapter, promoting a balanced ecosystem may not require launching a long list of new policies, rather providing an overarching coordination and focalisation of existing policies and initiatives on clear goals of BD market development.

7.3 Demand-side Actions

Policy challenge	Number	Status
Promote data-driven entrepreneurship and organizational change	6	SOME PROGRESS

Assessment Rationale

Big Data is a complex topic and requires a degree of vision by the businesses and organisations wishing to implement such initiatives. Complex initiatives are often also seen to be expensive and if organisations are to be encouraged to make such investments, especially if they are seen as part of some wider economic initiative, they will seek to identify alternative options for helping to fund that initiative. In this assessment we were looking for ways in which the Irish Government were providing support to businesses wanting to undertake Big Data related development in their business.

The Irish government has two specific measures supporting demand for Big Data in the Action Plan for Jobs 2014, one addressed to SMEs and the other concerning the revision of the legislative framework to accelerate the public sector adoption of open data. These initiatives are making progress and contribute to the market growth, even though they are at risk of falling short in the goal to accelerate widespread adoption, in order to make Ireland a leader in use as well as in supply.

Type of actions

This is the action included in the Action Plan for Jobs 2014:

- The launch of a targeted Call for Innovation Vouchers in the area of data analytics, enabling SMEs to receive some funding to implement Big Data innovation (managed by Enterprise Ireland).

Progress so far

The Innovation Vouchers call was launched in the Q3 of 2014 and applications started being opened in September.

Policy challenge	Number	Status
Incentivise data supply chains and the provision of shared data sets	7	NO ACTION FOUND
Promote awareness	8	

Assessment Rationale

For many Big Data and Open Data are synonymous with each other, although in reality there are many Big Data initiatives underway that rely solely on the organisations own data and make no use of Open Data. Organisations need to understand the power of the data they have within their business, for their own use and potentially as a commercial money making opportunity to sell the data to other interested parties. Likewise organisations need to understand what data is available to them from external sources, Open or otherwise, and where they can get it.

The Irish government is investing in the development of open data (as remarked below) but we did not find measures fostering the use of Big Data across all user sectors, incentivising the extraction, availability and exploitation of rich data sets in order to extract their value added and to promote data sharing (this means building the internal data supply chain, as for example advised by Accenture to successfully adopt Big Data innovation²²). Since the extraction and elaboration of data to make it usable requires organizational and technical investments, and organizations may have little incentive to share data sets, this suggests the need for incentives and policy intervention.

More generally, there are currently no awareness or communication campaigns by the Irish government promoting the knowledge and understanding of Big Data and its potential. This prevents many enterprises, especially SMEs, to even start investigating opportunities in this area.

Policy challenge	Number	Status
Government leading by example in the use and provision of open data sets	9	SOME PROGRESS

Assessment Rationale

Globally one of the factors that is limiting the uptake of Big Data is the presence of regulation that is, whether actually or simply perceived, to prohibit or inhibit the use of certain data.

Governments and other regulatory authorities are actively amending legislation to remove these barriers, whilst at the same time ensuring the rights of the individual for privacy and security are protected. Our assessment here looks for evidence as to what action the Irish Government are taking in this respect

The Irish government is revising the regulation framework to facilitate data analytics by public agencies and the development of open data sets. However, progress is slow and there is still much to be done for government bodies to actually lead by example in this market.

²² Accenture <http://www.accenture.com/microsites/it-technology-trends-2014/Pages/home.aspx#data-supply-chain.aspx>

Type of actions

This is the action included in the Action Plan for Jobs 2014:

- Further strengthening 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 national data infrastructure.

Progress so far

The Irish Government is working to change legislation which was holding back progress. For example, legislation has been passed to facilitate the development of a "patient identifier" in the Health area. There has been a review of the copyright regime too. The proposed Data sharing and Governance Bill was postponed in order to undertake a significant public consultation in the field.

7.4 Open Data Actions

Policy challenge	Number	Status
Promoting Open Data Portals and open standards	13	SOME PROGRESS

The Open Data policy is particularly relevant for the Big Data market. Within our policy challenges framework, open data has aspects relevant for the demand side (as the availability of open data will enable take-up) and for the enabling conditions (because it concerns regulation and supporting interoperability). Therefore we address it here for both aspects and look for evidence that action is being taken to promote the creation, awareness and usage of Open Data across the economy.

Assessment Rationale

Through the Department of Public Expenditure and Reform (DPER) the Irish Government has embarked upon an **Open Data** strategy, working with the Insight Centre in Galway to formulate a Roadmap and execute the strategy. This included the launch of an **Open Data** initiative, with 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. As part of this initiative DPER has adopted the G8 Open Data Charter prioritising the release of high-value datasets as Open Data.

These initiatives are actually only starting to be implemented but there is still much to do, to make open data sets actually available and searched for by stakeholders.

Type of action and progress so far

A portal (www.data.gov.ie) has been developed and "gone live" allowing access to over 400 datasets by November 2014. Nevertheless, a lot of work is still needed on usability of data, tracking users, transparency of updates.

One of the clear findings from the research undertaken amongst stakeholders for this report was the lack of awareness of what Ireland was doing with respect to Open Data. Initial thoughts were that this was perhaps highlighting an issue, however the strategy was only formally announced in July 2014 and the first major public initiative, which saw some 60 people attend, was not held until September 2014. It is therefore much less surprising that the level of awareness amongst the stakeholders was not higher. Further meetings with interested parties were held in October and November.

Initial observations of the Irish Open Data Portal are that in a short time they have attracted a significant number of datasets and more are being constantly added. At present it would seem that the data is being offered for free. Use of the data by commercial organisations for commercial gain should attract a charge and create a revenue stream for both the organisation providing the data and the government for hosting the data. It also does not seem that there is any attempt to capture who is using the data. Clearly introducing a charging mechanism for the data will require this information to be captured but it is also prudent to understand who is accessing what data to ensure that action can be taken should the data be misused in some way. This information will also allow the user to be advised when the data is refreshed or what other related datasets are available that may be of interest. Finally at the portal level there is no identification of the currency of the data (i.e. when was it last updated and when is the next update planned) high value data tends to have only a short lifespan so ensuring the potential user is aware of the currency of the data can help to promote its use.

7.5 Enabling conditions

Policy challenge	Number	Status
Develop Data Governance Frameworks for data ownership, control, access, sharing and interoperability	10	SOME PROGRESS

Assessment Rationale

As already discussed legal barriers exist or are perceived to exist with regard to what data is available and how it can be used. The public are also wary of how their data is accessed and used, in part following high profile instances around the world where personal data has been made public. All countries are having to review the regulation and guidelines that exist relating to data capture and data usage to ensure they do not stifle the benefit that data analytics can bring and at the same time ensure the privacy and security of the individual is protected.

The Irish government is dealing with data regulation concerning on the one hand data protection and on the other hand open data. There are ongoing efforts to revise the regulatory framework to remove barriers to data flows. However, there seems to be little action towards addressing the potential impact of data-driven innovation on competition regulation and on risks of increasing inequality.

Type of action:

The Action Plan for Jobs 2014 includes a proposed Data sharing and Governance Bill, which is focused mainly on the government sector and on open data issues and has been delayed, pending a public consultation.

The Technology Centres IC4 (The Irish Centre for Cloud Computing and Commerce) and IVI (innovation Value Institute) have also been engaged in work in the area of developing governance frameworks associated with Big Data.

A new Data Protection Unit is currently being established in the Department of An Taoiseach. The role of this unit is to implement a roadmap of activities, ensuring that Ireland's approach to data protection in the digital economy is best in class globally and serves as a support to economic development and Foreign Direct Investment. Its planned activities are the following:

- Establish inter-departmental committee on data issues and related structures

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

- Establish a forum for dialogue with industry/civil society on issues arising from the continuing growth in personal data usage and technology
- Strengthen the resources of the Office of the Data Protection Commissioner
- Establishment of a Dublin Office of the Data Protection Commissioner
- Engage intensively with EU partners and stakeholders in relation to ongoing negotiations on Data Protection regulation

This represents progress towards dealing with the data protection challenges in a holistic way.

Policy challenge	Number	Status
Build trust and confidence	11	NO ACTION FOUND

Building trust and confidence in Big Data by citizens and enterprises requires more than simple information about its potential benefits. The government as the arbiter of social interaction and conflict must understand citizens' and business actors' concerns, and should be responsible for informing citizens of potential digital risks and guarantee that they are well managed, protecting business and individual rights. The initiation of a new data protection unit in the Department of the Taoiseach and the work on regulatory frameworks go in the right direction but there is also a need for communication and dissemination, which does not seem to be currently implemented.

Policy challenge	Number	Status
Supply Data skills	12	SOME PROGRESS

Assessment Rationale

Core to the Irish Government's Big Data strategy is the creation of jobs. By encouraging the development of a Big Data industry in Ireland it is essential that the maximum number possible of jobs created are filled by Irish citizens and residents and not simply importing workers from overseas.

The Expert Group on Future Skills Needs (EGFSN) analysed this challenge in depth in the study "Assessing the Demand for Big Data and analytics skills" published in April 2014, and identified a long list of recommended actions. These actions have been taken on board by the responsible actors in the second quarter of 2014 (including DES, DJEI, EGFSN with relevant Departments and agencies) and are currently being implemented. However, this is one of the key challenges for the Big Data market development and it is imperative that the recommendations are implemented fully to satisfy the demand for data skills. A follow up on the progress of the implementation of the full set of recommendations contained within the EGFSN is to be made in the first quarter of 2015.

Progress so far

The study estimated potential job vacancies in Ireland between 12,750 and 21,000 by 2020 and suggested a wide range of measures to fill the gap, improve supply, and promote training. New courses targeting the area of data analytics have been launched. There was also a new round of the Springboard programme addressed to train workers in Big Data skills. It is interesting to notice that

the higher estimate for data skills vacancies is derived from a high growth scenario, where Ireland achieves its vision of leadership in the Big Data market.

Policy challenge	Number	Status
Meet new security challenges and promote a digital risk management culture	14	NO EVIDENCE

Assessment Rationale

Security and risk management challenges created via the Big Data initiative have been touched on elsewhere in this Gap Analysis, but it is perhaps the one area where such an initiative could succeed or fail, since a major security breach could set the whole strategy back or even see it fail altogether.

While we have not found specific measures promoting digital risk management practices in the potential Big Data user population, it is possible that within the ongoing pilot projects and in the R&D centres such as Insight new security challenges are being considered. Also, it is likely that the national authorities dealing with cybersecurity and IT security are developing new policy directions and practices for dealing with the digital risks generated by Big Data. Given these considerations, there seems to be insufficient evidence to assess this policy challenge.

7.6 Gap Analysis summary

The overall picture emerging from this policy review and gap analysis shows that Ireland has moved fast to meet the R&D challenges of the Big Data market, but this may not be sufficient to achieve its goal of European leadership. Table 11 below presents a summary of the gap analysis results, with an easy to understand code, from green to red, where green means policies on track, amber some progress and red that there are no policies. From the summary analysis we can see that for most policy challenges there is a need for further action.

Ireland's investments in R&D are timely, and based on the evidence collected, the choice to develop a network of specialised research centres is a good starting point to achieve a recognized leadership in the development of data analytics and privacy enhancing technologies. It is important that these investments are continued. There is however more that can be done to stimulate the development of a competitive Big Data industry. Ireland does have proactive innovation policies (such as the Entrepreneurship Disruptive Reform) but does not have more focused measures incentivising Big Data start-ups and promoting the development of data infrastructures and platforms, so that Ireland can become a "data hub" for the industry. The focus of current Big Data policies is mainly on R&D and data skills, disregarding the need for supporting the development of a balanced demand-supply ecosystem with a strong interaction between innovative suppliers and advanced users.

In fact, the demand-side policies appear to be still limited, even if there are some active measures and progress in terms of the support to organisational change and data-driven innovation (for example through the Innovation Vouchers programme). The development of the Open Data portal goes some way towards building the basis for "government leading by example", as well as the fact that one of the two Big Data pilots currently ongoing is by a government department. However, the stakeholder interviews underlined that there is a lack of awareness about the potential of Big Data among businesses, especially SMEs, and even where there is awareness there is a lack of

understanding as to how to initiate activity in the Big Data area. There have been attempts recently by the CeADAR Technology Centre to raise awareness of the value to business of Big Data through open day events, and this could be built on further. Among citizens there is either ignorance or concern about potential privacy threats. The main policy gaps therefore concern the development of policies to promote awareness of Big Data potential opportunities and benefits, an important pre-condition for the development of the market, and the development of practical measures incentivising enterprises to extract, valorise and share their data.

Big Data is a potentially disruptive innovation raising new and little understood challenges in multiple regulatory domains: we have identified the need for new data governance regimes, possibly with a holistic approach taking into account all of the data cycle, dealing with data ownership, sharing, interoperability, the implications of the data economy for competition and potential market abuse, and for social impacts on inequality and information asymmetries. The Irish government is starting to address some of the regulatory challenges, for example through the proposed Data Sharing and Governance bill, but there is still much to do. This will help in building trust and confidence in the data market, which goes beyond a simply defensive approach (insuring citizens that they will be protected from privacy violations).

Finally, there is one area which Ireland has prioritized correctly with a policy plan: meeting the demand for Big Data skills, improving supply through a mix of education, training and collaboration with industry. The lack of Big Data skills could be the single most important barrier preventing Ireland to achieving its goal of leadership in this market. There is widespread concern in Europe and the world about the lack of data scientists and data workers. Ireland has moved timely and is addressing the right actions, but the actual implementation of the policy plan should be a high level priority.

In conclusion, Big Data policy so far has been seen as essentially a technology innovation policy. In our opinion, to achieve the goal of Irish leadership in this market, greater coordination with other policy strategies is required, to maximise synergies with innovation and entrepreneurship policies. The Big Data strategy should be even more deeply embedded in the overall Irish growth strategy.

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S
PROGRESS AND FURTHER POLICY REQUIREMENTS

Table 11: Gap Analysis of Irish Policies - Summary

R&D / SUPPLY SIDE CHALLENGES	DEMAND-SIDE CHALLENGES	ENABLING CONDITIONS
<p>1. R&D</p> <p>Achieve recognized global leadership in R&D on data analytics and privacy enhancing technologies</p>	<p>6. Data-Driven Entrepreneurship</p> <p>Encourage data-driven entrepreneurship and organizational change enabling data-related innovation adoption across the economy</p>	<p>10. Data Governance Frameworks</p> <p>Establish governance frameworks for data ownership and control, access, sharing and interoperability balancing business and consumers interests</p>
<p>2. Competitive Big Data industry</p> <p>Build a competitive Irish Big Data industry stimulating the creation of start-ups and spin-offs developing apps, tools and data management services</p>	<p>7. Data Supply Chains and Provision of Shared Data Sets</p> <p>Incentivise the development of data supply chains within enterprises and the provision of shared data-sets</p>	<p>11. Build Trust and Confidence</p> <p>Build trust and confidence in data privacy and protection in the new data-driven environment</p>
<p>3. High Speed Internet</p> <p>Ensure widespread high-speed Internet connectivity across the country, particularly mobile broadband</p>	<p>8. Promote Awareness</p> <p>Promote Awareness of Big Data potential value and benefits by citizens and enterprises</p>	<p>12. Supply Data Skills</p> <p>Assure the supply and development of data analytic skills and competencies</p>
<p>4. Data Infrastructures and Platforms</p> <p>Develop data infrastructures and platforms in order to become the EU «data hub» for multinational companies</p>	<p>9. Government Leading by Example, Providing Open Data</p> <p>Government agencies leading by example in the implementation of Big Data technologies and the provision of open data sets</p>	<p>13. Open Data Portals and Open Standards</p> <p>Promote open data portals and open standards for data interoperability and access</p>
<p>5. Develop a Coherent Demand-Supply Ecosystem</p> <p>Develop a coherent demand-supply ecosystem, for example harnessing collaboration between start-ups and corporate players</p>		<p>14. Security and Digital Risk Management</p> <p>Meet new security challenges and promote a digital risk management culture</p>

Source: IDC elaboration on the review of Irish policies

Legend: Green cells: Policy on track; Amber cells: Some Progress; Red cells: No Action found; White cells: insufficient evidence to exclude the existence of initiatives

8. Policy Recommendations and Action Plan

8.1 Introduction

Building on the conclusions of the policy gap analysis, we present here the main recommendations suggested by IDC for Ireland, complemented by a detailed Action Plan identifying the responsible owners for implementing the actions and the timeframe of intervention. The recommendations will all be structured in the same way as follows.

Rx: short text with the recommendation.

Why: statement about the rationale of the recommendation and its objectives.

Actions: description of the specific actions needed to operationalize the recommendation, including the main actors responsible and the timeframe of implementation. The actions may be more than one. They will be explained in the text and summarized in a summary table for each recommendation (template below).

The timeframe indicated are: short term (2015); medium term (2017-2018); long term (2018 and beyond). This time frame only refers to the activities necessary to operationalize the actions, not to the timing of their expected impacts.

Owners: indicates the key leads for implementing the action. The owners are government departments/agencies, or groups established by government departments/agencies, however it is expected that other actors (private enterprise, industry associations, academics, etc..) will be brought into the implementation plan for each action as appropriate.

The following table presents a summary of the main actions, positioned in the policy area of reference. Policy challenges are the same as those analysed by the gap analysis. Since the policy challenges are interrelated, many specific actions can have an impact on more than one policy area.

Table 12: Summary of Policy Actions

R&D / SUPPLY SIDE CHALLENGES	DEMAND-SIDE CHALLENGES	ENABLING CONDITIONS
1. R&D Action 2.1; 2.2;2.3	6. Data-Driven Entrepreneurship Actions: 2.3; 2.5; 2.6; 3.1; 5.1	10. Data Governance Frameworks Actions:7.1; 9.1
2. Competitive Big Data industry Action: 2.5; 2.6	7. Data Supply Chains and Provision of Shared Data Sets Actions: 2.4	11. Build Trust and Confidence Actions: 6.2; 7.1
3. High Speed Internet Implementation of National Broadband Plan in progress and should be continued	8. Awareness Actions: 5.1; 6.1; 6.2	12. Supply Data skills Actions: 3.1; 4.1; 4.2; 8.1; 8.2
4. Data Infrastructures and Platforms Action: 4.1;4.2	9. Government leading by example; providing Open Data Sets Actions:5.2	13. Open Data Portals and Standards Actions: 5.2
5. Develop a coherent demand-supply ecosystem Action: 2.3;2.4;2.6; 3.1; 4.1; 4.2;5.1		14. Security and Risk Management Actions: 10.1; 10.2

8.2 Policy Recommendations

R1 Renew the mission and focus of the Big Data Taskforce with a supervisory role of the Big Data Action Plan in order to make sure that progress is made towards Ireland's leadership in the area of Big Data, which is the main goal of the Disruptive Reform.

Why: While the single actions suggested for the 2015 Action Plan will be monitored individually, there is a need for a single actor responsible for overarching coordination and monitoring, to make sure that the strategic goals of the plan are met. The Disruptive Reform clearly states as a main goal “building on existing enterprise strengths to make Ireland a leading country in Europe in the area of Big Data and Data Analytics”. There is however no specification of how this leadership will materialise and in which fields (for example, R&D, market, employment growth, investments attraction). There are quantitative Big Data employment targets by scenario in the report on Big Data skills, but they are only one aspect of potential leadership. Therefore, it is not clear how progress towards leadership will be tracked. In addition, policy initiatives of this strategic relevance need to be constantly monitored and revised if necessary, as external conditions evolve and may change the socio-economic context, or the first successful actions start making their impacts. This is particularly true in an emerging market such as Big Data.

Actions

1.

- 1.1. DJEI should take the lead to select and name a renewed group of Big Data experts in order to constitute a renewed taskforce responsible for these actions for at least the next 3 years in order to monitor progress towards leadership. The main government bodies responsible for the Big Data actions should be represented in this taskforce, but representatives of the private sector and of the main centres involved in the development of the ecosystem should also be included to make sure that the evolution of supply-demand dynamics in Ireland is correctly understood.
- 1.2. The renewed Big Data Taskforce as a first act should elaborate and adopt a clear definition of the main goals of the Disruptive Reform against which Ireland's progress in achieving a leadership position in the area of Big Data can be tracked. This should include the identification of measurable targets and Key Performance Indicators to be measured once a year in order to assess progress also on the basis of objective evidence.
- 1.3. The new Big Data should produce a short report once a year assessing the progress made towards these goals and provide recommendations on how the following years action plan should be confirmed and/or updated/revised if needed.

About Key Performance Indicators

Based on IDC's research, we suggest indicatively the following measurable KPIs for Ireland's leadership in Big Data. This suggestion is made only to provide an example of feasible indicators which do not necessarily require further intervention by IDC.

- KPI 1: Big Data market's revenues in Ireland by 2018 should be higher than the amount estimated by IDC in its current likely forecast scenario²³ (80 M\$). The relative weight of the Irish market within the Western European market (1.2% in 2018) should be correspondingly higher. For example, Ireland could aim at almost doubling that share to 2% of the WE data market by 2018, with revenues of 135 M\$ (160% higher than the current estimate). However, this target should be decided by the Big Data Taskforce after consultation with relevant stakeholders. Furthermore, the sizing of the market in this report is based on the domestic spend. Consideration should be given to developing a KPI which takes account of the export market.
- KPI 2: Ireland should achieve a certain amount of inward foreign investment correlated with the Big Data market (target to be established by IDA at the start of 2015);
- KPI 3: Ireland should achieve the Big Data and analytics employment growth estimated in the high growth scenario presented in the study "Assessing the Demand for Big Data and Analytics Skills, 2013 - 2020";
- KPI 4: Ireland should achieve by 2018 a level of adoption of Big Data by Irish industries higher than the EU average, measured through the percentage of Irish enterprises on total who use data technologies (as opposed to traditional use of data, see Annex D for the definition of data users), based on the benchmark that will be developed by IDC on behalf of DG Connect of the EC in March 2015.

(Note: The study "Measuring the European Data Market" will develop indicators at the EU level and for each of the 28 EU Member States on the number of data companies and data user companies, among others. For more details see Annex C. The results of this study will be available free of charge, after EC approval. The timing of publication is uncertain but will be within 2015. IDC will

²³ IDC report "Western Europe Big Data Technology and Services 2011–2013 Market Size and 2014–2018 Forecast by Country and Segment", August 2014

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

develop forecast scenarios for adoption of Big Data in each EU MS based on a survey and a likely scenario, not on "policy-push" developments. Therefore it will be possible for Ireland to estimate an accelerated "leadership-related" scenario with higher adoption targets).

Other potential KPIs are the following:

KPI 5 Spending on R&D Big Data priority area-Big Data Taskforce should seek a report from prioritisation group.

KPI 6 European funding won for RD&I in Big Data - Big Data Taskforce should monitor and benchmark compared to other Member States.

Table 13: Renew the Mission and Focus of the Big Data Taskforce

Actions		Timeframe	Owners	Challenge being Addressed
1.1	Renew the mission and focus of the Big Data Taskforce with the goal to oversee progress towards the strategic goals of the Disruptive Reform.	Short	DJEI	Overarching Recommendation
1.2	Identify and adopt specific targets of the Big Data Disruptive Reform including measurable KPIs.	Short	Big Data Taskforce	Overarching Recommendation
1.3	Monitor progress annually, based on the KPIs, and produce a report updating/revising the main actions.	Annually	Big Data Taskforce	Overarching Recommendation

R2 Promote the development of a coherent Big Data demand-supply ecosystem

Why: The Big Data market is in an emerging, not yet mature, phase of development. By focusing on developing a coherent ecosystem Ireland can bridge the gap between R&D, innovation and adoption and take the lead developing concrete solutions and applications. The Irish government has already invested into the development of R&D in the field, but more can be done in promoting a virtuous circle between supply and demand and incentivising supply and demand stakeholders. In order to achieve the benefits of data-driven innovation, policy must take into account the full data value cycle and the role of all stakeholders. A successful ecosystem for Big Data requires data governance regimes that provide incentives for data sharing; for the interoperability of data-driven services; empowering also individuals (consumers) to reuse their data across interoperable applications and services (data portability). Achieving this will help Ireland to gain leadership in the EU and the global data market in front of strong competition by other countries and to continue attracting ICT multinationals active in the field by providing application development capabilities and user proximity. A solid and competitive domestic industry and market will make Ireland more attractive to foreign direct investments.

The ecosystem should cover all the data value chain including data storage and infrastructure providers, developers of tools, data markets and data brokers, developers of analytics and applications, data holders, data users and data re-users. It should link together global players, SMEs, start-ups, infrastructure providers and Big Data adopters in as many industries as possible, as

well as the research and academic communities. Therefore, better networking across all of the economy should be promoted. As indicated in our analysis of the Irish market, we see the largest opportunity for new local Irish technology companies in the application layer as it is here where there is the potential for the creation of differentiated solutions tailored to the specific needs of a sector or specific business need. In parallel, it makes sense for Ireland to strive to attract FDI in the areas of the value chain where the domestic industry may find it difficult to compete.

On the other hand, Ireland should identify and focus its own areas of strength in terms of application areas and vertical markets. Big Data, as all ICTs, is a horizontal innovation valid for all sectors. However, it will be implemented differently and at different speed across the economy, depending on pre-existing conditions and skills. Given the strong competition, it will be important for Ireland to identify early on and support the interaction between the strongest potential actors, for example the most active start-ups and most innovative adopters among large users.

Actions

- 2.1. The main responsible actors should reinforce and continue funding the research and networking activities of the R&D centres in Ireland.
- 2.2. The main responsible actors should ensure that the activities of the R&D centres extend across the full RD&I spectrum including supporting go-to-market, applied research projects with business actors, for example with a co-funding model, and also providing consulting and skills training for the exploitation of data-driven innovation.
- 2.3. To develop a coherent Big Data demand-supply ecosystem, activity needs to be stimulated across the full spectrum of RD&I activities. An R&D tax credit is in place in Ireland to stimulate activity in firms to undertake RD&I. However, there is a need to explore whether the existing R&D tax credit system in Ireland supports the types of activities being undertaken in the area of Big Data, and to develop a shared understanding by industry as to how the R&D tax credit guidelines can be utilised to support Big Data applied research and implementation projects. An industry focused group would need to be convened to complete such an exercise. The Revenue Commissioners should be engaged to help clarify uncertainties and to determine how any gaps identified by industry might be addressed. There are examples in other countries which might provide inspiration, from the French "Innovation Tax credit" for SMEs, to Italy's tax relief for investments in R&D intensive start-up companies and tax credits for hiring researchers.
- 2.4. A key aspect of developing the big data ecosystem is to unlock the potential of large datasets. Datasets developed and held by organisations may contain value that is not being exploited by their owners (and indeed such exploitation may not be of key relevancy to the main business model of the organisation). Sharing/providing access to large datasets may provide opportunity for the development of new products and services by other entities. Providing an incentive to dataset owners to share/provide access to these datasets (and advertise their availability) would potentially offset the risk and effort that dataset owner organisations would need to undertake in the provision of this data. For example, as a parallel to the French policy of a reduced tax rate on revenue derived from sale or licence of patented or patented technology, the opportunity to provide a tax incentive for sharing/providing access to databases through a reduced tax rate on revenues derived from sale or licencing of datasets could be explored for Ireland. This could be done through common data platforms in the "innovation spaces" (see R3). The opportunity to implement this could be examined as part of the Knowledge Development Box.
- 2.5. DJEI and EI should determine how they can best leverage incentives and funding and mentoring schemes to start-ups and small innovative enterprises developing Big Data innovation, also leveraging the Entrepreneurship Disruptive Reform in the Action Plan for Jobs

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

2014. The option of developing an incubator could be considered. This should be done by leveraging the support of the research centres who are likely to develop potential business ideas. This could also be promoted through prizes and awards (such as naming the Big Data entrepreneur or Data scientist of the year), in coordination with the awareness campaign initiative.

- 2.6. EI should review its innovation programmes to see how they can be developed to include Big Data among their targets, promoting data-driven innovation, motivating enterprises to adopt it, identifying and exploiting synergies with existing actions. This should include for example educating the EI staff to include Big Data opportunities in their digital transformation projects (for example in the Manufacturing: national step change program). Also, EI should make sure that the Entrepreneurship actions promoting start-ups, the Youth Entrepreneurship actions and the Inward Entrepreneurship initiative to attract foreign entrepreneurs to Ireland, all include Big Data in their eligible areas of innovation.

Table 14: Promote the Development of a Coherent Big Data Demand-Supply Ecosystem

	Actions	Timeframe	Owners	Challenge being Addressed
2.1	Reinforce and continue funding the research and networking activities of the R&D centres in Ireland.	Short	DJEI , SFI, EI, IDA	1 R&D
2.2	Ensure that the activities of the R&D centres extend across the full RD&I spectrum including supporting go-to-market, applied research projects with business actors, for example with a co-funding model, and also providing consulting and skills training for the exploitation of data-driven innovation.	Short	DJEI , SFI, EI, IDA	1 R&D
2.3	<p>A Big Data industry focused group should be convened to:</p> <ul style="list-style-type: none"> • Review the R&D Tax Credit guidelines in order to determine whether the existing R&D tax credit system in Ireland supports the types of activities being undertaken in the area of Big Data. • Develop a shared understanding by industry as to how the R&D tax credit guidelines can be utilised to support Big Data applied research and implementation projects. • Engage with the Office of the Revenue Commissioners to determine how any uncertainties or gaps identified in the R&D tax credit system might be addressed for Big Data. 	Medium	DJEI, Office of the Revenue Commissioners	<p>1 R&D</p> <p>6 Data-Driven Entrepreneurship</p> <p>5 Develop ecosystem</p>

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

2.4	Incentivize enterprises to collect their own data and make it available for sharing in an anonymized and aggregated form.	Short	Department of Finance, DJEI	<p>5 Develop ecosystem</p> <p>7 Develop Data supply chains and data sharing</p>
2.5	Provide specific incentives and access to funding and mentoring schemes to start-ups and small innovative enterprises developing Big Data innovation, also leveraging the Entrepreneurship Disruptive Reform in the Action Plan for Jobs 2014.	Medium	DJEI, EI	<p>2 Competitive Big Data Industry</p> <p>6 Data-driven Entrepreneurship</p>
2.6	Explore the extent of EI programmes to see how they can be developed to include Big Data.	Short	EI	<p>2 Competitive Big Data Industry</p> <p>6 Data-driven Entrepreneurship</p> <p>5 Develop ecosystem</p>

R3 Review the opportunity for Ireland to leverage the participation in the EU Big Data Value Partnership to implement “innovation spaces” in Ireland

Why: “Innovation spaces” are a new concept that the EU Big Data Value cPPP is going to implement. They can be for example networked labs used to carry out experimentation and development of Big Data services and apps. The innovation spaces may for example enable experiments with Big Data sets without the constraints of data protection regulation and to test innovative apps and services fostering the collaboration between potential suppliers (an example is the “sandbox” developed by the main statistical institutes and based in Ireland). They could also serve as demo centres for SMEs or enterprises who want to understand better the potential of Big Data for their business and develop potential business plans. Finally they can also train young professionals or workers with a different background to work with Big Data, filling an important role in the development of data skills.

Actions

3.1. At present only France²⁴ and Germany²⁵ are experimenting with innovation spaces in some way. If Ireland launched a Big Data innovation space within 2015, it would have the opportunity to take advantage of the co-funding by the EC within the Big Data Value cPPP (contractual Public-Private Partnership) and be among the pioneers in Europe to do so, with the chance to take the lead in selected application development areas. Other initiatives could include the launch of specific calls for Big Data and developing prizes and rewards for researchers and innovators (for example awards for ‘Big Data scientist of the Year’ or Big Data Entrepreneur, or “hackathons” (software competitions) to develop apps). This could be managed in synergy with the awareness building actions.

²⁴ See the “Big Data Personal trust space” developed by the Fondation Internet Nouvelle Génération, quoted in par.6.3 of this report

²⁵ See the Smart Data Innovation Lab at Karlsruhe Institute of Technology, quoted in par.6.3 of this report

Table 15: Review the Opportunity for Ireland to Leverage the Participation in the EU Big Data Value Partnership to Implement “Innovation Spaces” in Ireland

Actions		Timeframe	Owners	Challenge being Addressed
3.1	In consultation with Big Data R&D centres, review the opportunity for Ireland to launch an innovation space in 2015, with a view to taking a lead position in selected application development areas whilst leveraging co-funding by the EC within the Big Data V-cPPP.	Short	Insight ²⁶ , H2020 High Level Group	5 Develop ecosystem 6 Data-driven Entrepreneurship 12 Supply Data skills

R4 Become a leader in HPC for Big Data

Why: High-performance data analysis (HPDA) is the term IDC coined to describe the formative market for big data workloads that exploit HPC resources. The HPDA market represents the convergence of long-standing, data-intensive modelling and simulation (M&S) methods in the HPC industry/application segments and newer high-performance analytics methods that are increasingly employed in these segments as well as by commercial organizations that are adopting HPC for the first time.

By leveraging existing assets Ireland could gain the leadership in an emerging field with leading edge commercial applications, particularly in Finance, Pharmaceuticals, and Manufacturing, also by innovative SMEs. This would strengthen the ecosystem and provide key attractive capabilities for Big Data multinationals. Ireland has a role in the European HPC infrastructure through ICHEC (Irish Centre for High End Computing) which could be leveraged for this action.

Actions

4.1. The Irish government should reinforce support for HPC and make a decision to expand HPC Big Data related activities, supporting the technology transfer and early adoption of Big Data technologies by enterprises, particularly SMEs. This includes for example innovative SMEs who could develop new tools and services for their Irish and international customers, not simply user SMEs and also start-ups in this field.

HPC-based advanced analytics are relatively new to national HPC centres, and IDC believes ICHEC is well positioned to become a European leader in this field. ICHEC's condominium-style organizational model would make the resources widely available to Ireland's scientific and engineering research community, with outreach to Ireland's industrial-commercial community as well. Existing collaborations, such as ICHEC's partnership with CarTrawler, shows that the centre is capable of helping commercial firms with advanced analytics needs as well as those requiring support for HPC-based modelling and simulation. ICHEC is already active in training data analysts from various education backgrounds (for example graduates in biology who need to use HPDA for research in bio informatics). This training activity could be increased, including also upskilling professionals and employees from interested enterprises in data analytics and Big Data technologies.

²⁶ The Insight Centre is included as an owner of the action in this instance due its unique position within the Big Data Value Association, which signed the BDV-cPPP with the EC.

4.2. Ireland should put a priority focus in identifying and pursuing opportunities to extend access to and engagement with HPC infrastructure, particularly for SMEs, through H2020.

Table 16: Become a Leader in HPC for Big Data

Actions		Timeframe	Owners	Challenge being Addressed
4.1	Ireland should expand its HPC Big Data related activities by promoting the early adoption of Big Data technologies particularly by start-ups and SMEs, through co-funded projects, ad-hoc consulting, the provision of testbeds and access to HPC resources, and Big Data skills training. In order to do this Ireland should increase competitive funding for HPC.	Medium	DJEI, EI, IDA, SFI	4 Data Infrastructures and Platforms 5 Develop ecosystem 12 Supply data skills
4.2	Ireland should put a priority focus in identifying and pursuing opportunities to extend access to and engagement with HPC infrastructure, particularly for SMEs, through H2020.	Medium	H2020 High Level Group	4 Data Infrastructures and Platforms 5 Develop ecosystem 12 Supply data skills

R5 Identify and promote more scalable Big Data pilots and strengthen the Open Data Portal

Why: There is a need to prove-demonstrate the business case for Big Data in order to promote adoption. Also to provide the solutions and applications tailored for the vertical markets where they can provide the greater benefits. The Irish government should enable the adoption and use of Big Data by promoting use pilots leveraging the collaboration between small enterprises and large users, targeting sectors where pilots can be scalable and have the maximum potential impact.

Actions

5.1. A call should be launched for proposals for innovative Big Data pilot projects. These pilots should be co-funded by the state, either through grants or activating the collaboration of public research and innovation centres. The call should be open to all interested parties, but the taskforce should elaborate the eligibility and selection criteria of these pilots in collaboration with EI and IDA by identifying those with the highest scalability and impact potential. This could be done by examining the relative economic relevance (contribution to GDP) of the main verticals and the Big Data market size by vertical estimated by IDC, as well as the type of Big Data opportunities. Main criteria should be the level of potential impact on the economy as well as the potential for data-driven innovation to generate benefits for the interested organizations and the overall economy. Sectors which could be prioritized could include:

- Government and healthcare, because there is a very high potential impact of Big Data innovation in these sectors, and being public sector may require support to elaborate the organizational and practical solutions needed to adopt Big Data. Besides, the government

should lead by example and through open data, government can contribute to stimulate Big Data innovation across the economy. Healthcare is universally considered as a high potential sector, with extremely complex organizational and sensitivity issues for Big Data innovation. The stakeholders at the workshop ranked it first both as an opportunity and as a threat (given previously failed IT projects in Healthcare).²⁷ In addition, Ireland has a National Health innovation hub which might be leveraged for the pilot projects.

- Manufacturing is one of the largest sectors, and the benefits of Big Data adoption would reverberate strongly across the Irish economy. In addition, leveraging HPC for Big data in this sector is a very interesting opportunity and would help Ireland to achieve leadership.
- Pharmaceuticals is a sector where Ireland is very strong, with high potential demand for HPC based Big Data applications and services. This would help Ireland achieve leadership at the global level.
- Finally, tourism is a low-technology industry, highly fragmented and traditional, but quite important for Ireland. The perspectives of tourism growth are very high in the next years, if countries are able to modernize their offering and attract the new tourists' flows particularly from Asia-Pacific. A specific effort to modernise tourism through Big Data applications and services exploiting customer data and updating marketing techniques could have very positive results for Ireland's growth. In addition, Big Data does not require high capital investments and can be adopted also by small enterprises as those in the tourism sector.

There are already several initiatives promoting innovation adoption in these sectors: Big data should be promoted as an essential component of these innovation initiatives. The pilots could be funded by the actors involved, with some incentives by the government (for example tax - credits or RD&I grants for the R&D and innovation component). The pilots could also be used to train interns and/or develop required data skills and multi-competence teams. Innovation - initiatives such as the Manufacturing: National Step Change and the National Health Innovation Hub could be leveraged to do so.

- 5.2. The Irish Government should continue investing in the Open Data Portal reinforcing its capabilities to make available open data sets for exploitation. This is an important driver of Big Data adoption in the government sector but also by private sectors leveraging open data.

²⁷ It is noted that there is now a Government approved strategy on eHealth called "An eHealth strategy for Ireland" published in December 2013. In addition there is a Chief Information Officer appointed to head up the eHealth agenda along with the development of an Irish eHealth ecosystem.

Table 17: Identify and Promote More Scalable Big Data Pilot and Strengthen the Open Data Portal

Actions		Timeframe	Owners	Challenge being Addressed
5.1	Launch call for proposals for innovative pilot projects to be co-funded by the state. Develop criteria to select pilots with the highest potential for scalability, identifying the sectors where Ireland is strongest and is more likely to achieve leadership.	Short	Big Data Taskforce, DJEI, EI, IDA, SFI	8 Building awareness 6 Data-driven entrepreneurship 5 Develop Ecosystem
5.2	Continue investing into the Open Data Portal, focusing funding to make available public data sets ready for exploitation and use.	Medium	DPER, Implementation group on Open Data, relevant Government Departments and Agencies	9 Government leading by example 13 Open Data Portals and Standards

R6 Launch awareness campaigns promoting trust and confidence in Big Data innovations

Why: In order to enable adoption and take-up, enterprises need to become aware of the potential use and benefits of Big Data and analytics. There is still a widespread lack of understanding of the potential use and benefits of Big Data and analytics outside the ICT industry. Many enterprises are not sufficiently aware of its potential value and will not consider themselves as potential users, especially SMEs. Many enterprises are also unaware of their own data, or are uncertain of ownership, control and usage dynamics, particularly in traditional industries. Some companies ignore that there are platforms providing data analytics services and that big data can substitute for some other, more expensive technologies. This requires an ad-hoc communication effort.

In the same way, many citizens are aware of the potential threat to their privacy due to the massive collection of data, but are not at all aware of the ways in which these risks are managed or could be managed, and of the potential benefits of greater transparency, participation and choice for them. Also there is a risk that any major breach of privacy or even global news in this field (like the mass surveillance by US agencies uncovered by Edward Snowden) might represent a strong brake on market development.

The two initiatives could mutually reinforce each other, as enterprises would be more confident of potential demand, and citizens would become aware of the potential offerings of services.

Actions

The Irish Government should seek to raise awareness targeted to:

- 6.1. Enterprises and web entrepreneurs, focusing on the potential competitiveness and revenue growth impacts of data-driven innovation and the ways to achieve them;

6.2. Citizens, to promote awareness about potential Big Data value and benefits in order to build trust and confidence, explaining how privacy risks can be managed.

The campaign for enterprises should feature good practices and pilot examples, and attract them to the innovation spaces / excellence centres in order to learn more. Both awareness campaigns could be linked with the Research and Innovation Awards schemes highlighted previously for consideration (see R 3).

Table 18: Raise Awareness of Big Data with a Focus on Promoting Trust and Confidence in Big Data Innovations.

Actions		Timeframe	Owners	Challenge being Addressed
6.1	Raise awareness of Big Data across enterprises and web entrepreneurs with a focus on impacts, on data availability and use, showcase of good practices and pilots and through the use of awards.	Medium	DJEI, EI, IDA, SFI	8 Awareness building
6.2	Raise awareness of Big Data value and benefits for citizens so as to build trust and confidence and to explain how to manage and limit privacy risks.	Long	Department of An Taoiseach	8 Awareness building 11 Build trust and confidence

R7 Develop an enterprise-driven data protection and privacy agenda

Why: The EU Data Protection Directive revision must still be approved by the EU Council of Ministers and implemented. There is still time²⁸ for the Irish Government to lead a negotiation and suggest ways to implement it so that no major barriers are created to the development of the Big Data market development and international trade and investment and to ensure that EU/ Irish businesses can build their international competitiveness while respecting data-protection principles.²⁹ There is worry in the business environment that the revised Directive may unwillingly create greater obstacles to business than expected, perhaps due to an under-evaluation of the practical problems related with Big Data business development. The development of Big Data solutions respectful of data privacy could be a competitive advantage for EU businesses. But on the other hand, if the implementation of the Directive is fragmented and uneven across the main EU MS, and if the main implementation conditions become a constraint to the collection and use of large EU data sets (which are freely used by entities such as Google) this may become a real barrier for EU enterprises. There is also a need for incentives for enterprises to invest into privacy-enhancing technologies.

Actions

7.

7.1 The new Data Protection Unit of the Irish Government should develop and share at EU level a policy agenda on data protection and privacy which takes into account business development

²⁸ Research was carried out in autumn 2014.

²⁹ It is noted that the EU and US have agreed Trade Principles for Information and Communication Technology Services: http://trade.ec.europa.eu/doclib/docs/2011/april/tradoc_147780.pdf.

and competition needs, and international business practice. Ireland, as an open economy with the goal to become leader of the Big Data market, has a clear interest to do so. On the one hand, Ireland needs to support the European policy carrying out a strong data protection regime to provide comfort and security to citizens that the personal data they share is secure and not subject to abuse. On the other hand, Ireland should negotiate EU rules which allow businesses built on data analytics to operate and to compete on an equal footing with companies elsewhere and which support the legitimate flow of data internationally that stimulates trade and investment. By focusing on the policy areas where the ongoing EU policies on Data Protection and on Big Data may be potentially contradictory, Ireland could propose feasible and usable solutions for the development of this much needed regulation. At the very least, Ireland should be aware of potential problems and focus on how to prevent them at the national level.

Table 19: Develop an Enterprise-driven Data Protection and Privacy Agenda

Actions		Timeframe	Owners	Challenge being Addressed
7.1	Ireland should develop a policy agenda on Data Protection and Privacy issues taking into account Big Data business development and competition requirements, and which supports international trade and investment. Ireland should bring this agenda forward at the EU level, in order to avoid the creation of unnecessary barriers for enterprises in the implementation of the forthcoming revised Directive.	Short	Department of an Taoiseach	11 Build trust and confidence 10 Data Governance Frameworks

Bringing forward an enterprise driven agenda at the EU level should support the development of the Big Data market in Ireland and Europe and enhance the ease of doing business associated with cross-border data flows.

R8 Prioritize a focus on data skills development for the Big Data market, including education, training and attractiveness actions

Why: Most enterprises lack the appropriate skills to implement big data; they should be encouraged to recruit such talent. There is a double issue here. First, potential Big Data user enterprises may not be aware that they need such skills. The suggested awareness campaigns and demand stimulations actions should help to solve this problem. Second, enterprises may have difficulty in recruiting skilled staff, or may believe that data scientists have too much of an academic approach, and are not sufficiently able to address business issues. The risks of a gap in data skills supply have been thoroughly examined by the study on "Assessing the Demand for Big Data and Analytics Skills".

However, the implementation of the recommendations outlined in this report is imperative if Ireland is to develop a Big Data leadership position. In the absence of such skills, other measures taken to nurture a big data industry become in part redundant. Thus, the importance of delivering

on the recommendations by the EGFSN cannot be overemphasised. If Ireland wants to accelerate the growth of the Big Data market, these initiatives should be stepped up, and particularly the initiatives concerning work placement and internships should be increased to match demand and supply. It is considered that further efforts should be planned to train professionals or employees with a business/ICT background in the Big Data field in a context of a life-long learning experience.

This policy action needs to be well understood. It is not only addressed to reduce the supply-demand gap of data skills. It is an action which a double goal: an improvement of the skills on the one hand and an increase of the enterprises awareness about the Big Data opportunities. This action needs to be well interpreted by enterprises and their engagement in the process is fundamental.

Actions

8.

8.1 The actions recommended by the EGFSN Report 'Assessing the Demand for Big Data and Analytics Skills ' to prevent a data skills gap in Ireland should be implemented fully and without delay.

8.2 A focus should also be put on training and upskilling of professionals or employees with a business/ICT background in the Big Data field. Specific initiatives should be launched to achieve this through the use of existing schemes such as the Spring Board Programme, the Skillnets Programme and relevant training courses offered by the Irish research centres.

Enterprises could also be incentivized to use internships to develop Big Data related innovation projects, for example with public funds paying for all or part of the interns' compensation. These incentives and internships could be linked with the agreement that if the project meets expected performance targets, the intern should be hired to develop it. The interns could be recruited both from higher education institutions, or could be professionals having successfully undergone upskilling or high quality re-training courses. These actions could be funded by the schemes already available (EGFSN Big Data Skills report), including the SFI Industry Fellowship Programme and the Irish Research Councils Enterprise Partnership scheme and Employment Based Postgraduate Programme whereby Masters and PhD candidates could undertake research work of direct relevance to the firm. The evolution of the later scheme to allow for a rolling call, rather than a once a year call, would provide greater flexibility to enterprise to engage in such schemes.

These internships and work placement initiatives should be coordinated with the launch of the innovation spaces (as the trainees could be trained there) and the pilot projects (where they could be employed).

Within the context of initiatives promoting the attractiveness of ICT careers and STEM education for secondary school students, the potential of Big Data careers should be included and clearly explained.

Table 20: Improve the Demand-Supply Match of Big Data skills

	Actions	Timeframe	Owners	Challenge being Addressed
8.1	Implement the Actions of the EGFSN Report 'Assessing the Demand for Big Data and Analytics Skills'.	Short	DES, HEA	12 Develop data skills
8.2	Utilise and evolve existing schemes to support training and upskilling of professionals or employees with a business/ICT background in the Big Data field.	Medium	HEA, IRC, SFI	12 Develop data skills

R9 Develop and promote guidelines for data ownership and control, access, sharing and interoperability, with a holistic policy approach

Why: As with other countries, Ireland faces the challenge of supporting the development of better data governance regimes to overcome barriers associated with data ownership and control, access, sharing and interoperability of data, balancing business and consumer interests. All these issues require a holistic approach to the regulatory framework for Big Data, so that new challenges are understood and dealt with in a coherent way. Improved data governance regimes should seek to overcome barriers (subject to legitimate restrictions such as privacy) so as to avoid potential issues, for example:

- if a company, thanks to data technologies, gains the upper hand in the business relationship with other, maybe smaller, companies or with individuals, this may exacerbate inequalities of power. A typical example is the use of Big Data by health insurance companies to deny health coverage to certain individuals because of risk assessments based on his/her lifestyles, or the use of data technologies to predict employees' performance with influence on career or pay decisions.
- significant investments are potentially required to develop and maintain databases, meta-data and related algorithms. Some organizations may lack the incentives to share the data they own and control. Traditional IPR regimes may not be appropriate to reward the ownership and sharing of data sets or to protect them from misuse (see also R2.4). There may also be a tension between data owners and data re-users, which may prevent the exploitation of data for new services.

Public authorities must keep a watch on potential competitive issues and make sure that the main stakeholders respect the principles of fair, transparent and open competition in their interactions in the data value chain. As indicated by the OECD, promoting the free flow of data and encouraging data availability raises new issues of market regulation and public interest. Furthermore, governance frameworks which incentivise data sharing and interoperability should be promoted.

This could be achieved through the development of guidelines that promote better data governance across the economy. These guidelines should be developed with the collaboration of industry, identifying the most appropriate behaviour of organizations in the development and management of data sets. This includes the impact of Big Data on competition.

Guidelines for data governance should be developed for datasets developed in Ireland. However, in the future, many companies will be working on datasets originating from other countries, and so companies also need guidance as to how to deal with data governance approaches developed elsewhere. This area of governance frameworks has been explored, to some extent, by a number of the Irish research centres including the Technology Centres IC4 and IVI and so there may be opportunity to build on work previously done in Ireland in this area.

Actions

9.1 DJEI in collaboration with the Data Protection Authority, other relevant government departments and industry, should develop coherent guidelines which will promote a data governance regime for business which addresses data ownership and control, access, sharing and interoperability and provides guidance to firms in light of changing competition dynamics. This will require analysing and taking into account the new challenges raised by data-driven innovation in terms of preventing data abuse, reviewing the IPR regime and developing incentives for data sharing and interoperability. Account should also be taken of issues arising for firms dealing with datasets developed in other jurisdictions. Some work has already been done in this area in the Technology centres IC4 and IVI, and there maybe opportunity to build on this.

Table 21: Develop and Promote Guidelines on Data Governance

	Actions	Timeframe	Owners	Challenge being Addressed
9.1	Develop and promote guidelines for firms on the governance of data, including competitive issues, ownership and control, access, sharing and interoperability, with a view to incentivising data sharing and interoperability.	Medium	DJEI, Data Protection Authority	10 Data Governance Frameworks

R10 Develop and promote a digital risk management culture and guidelines for its implementation by enterprises

Why: Data-driven innovation requires an environment where security does not prevent sharing massive volumes of data. This creates new types of security challenges as well as new risks of misuse or mistakes in the use of data, with foreseen but also unforeseen consequences. These risks are more elevated when analytics are used for decision automation in dynamic environments, in which case the dynamics of the environments need to be properly understood as well. This challenges current trends in the “democratization” of data analytics, where data and analytics are expected to be used by everyone, while increasing the need for a culture of digital risk management across the data ecosystem. Simple technical fix-it solutions will not be sufficient.

The identification and promotion of guidelines for good practices in digital risks management will:

- help enterprises to feel safer in entering the Big Data market and reduce uncertainties about potential risks, which may be a barrier against companies’ adoption of Big Data technologies;

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

- reduce the time to market for new entrants to the Big Data area by reducing the time burden required to identify digital risks and determine how to address them;
- promote the development of a Big Data sector in Ireland as one which manages digital risk, which can in turn be used to promote Ireland as a location for FDI in the Big Data.

These risk management guidelines are particularly relevant for the private sector but may also be useful for the public sector, to provide guidance for the exploitation of public data sets in a safe way.

Actions

- 10.1 DJEI and its agencies should support the analysis of the digital risks generated by Big Data by private and public stakeholders, and encourage the user industries to develop guidelines on how to manage these risks, following the model of the risk management practices. Specifically this could include including ex-ante Big Data risk assessment, decisions on Big Data risks treatment, developing Big Data specific security measures and preparedness plans. More generally, these activities should help to promote a digital risk management culture.
- 10.2 Data controllers and enterprise decision makers should be required to develop and implement Big Data risk management practices if they receive State funding for Big Data projects or innovation, following good practices in the area.

Table 22: Develop and Promote a Digital Risk Management Culture and Guidelines for its Implementation by Enterprises

Actions		Timeframe	Owners	Challenge being Addressed
10.1	The Irish government should support the analysis of new digital risks created by Big Data and encourage industry to create guidelines to deal with them.	Medium	DJEI, EI, IDA, SFI	14 Security and digital risk management
10.2	Data controllers and enterprise decision makers in the public and private sector should be required to implement a Big Data digital risk management strategy if they receive State funding for Big Data activities.	Medium	DJEI, DPER, EI, IDA, SFI	14 Security and digital risk management

Annex A - Vertical Market Opportunity Analysis

The data in the sections below come from a variety of sources. The number of enterprises in Ireland in a given sector is drawn from the most recently available Eurostat data. The Irish spend on IT comes from the latest quarterly data (Q3 2014) published by the Insights programme at IDC. In all of the charts the x axis reflects the proportion of enterprises in that vertical sector (in Western Europe) using Big Data for the particular initiative, based on the survey results.

Telecommunications

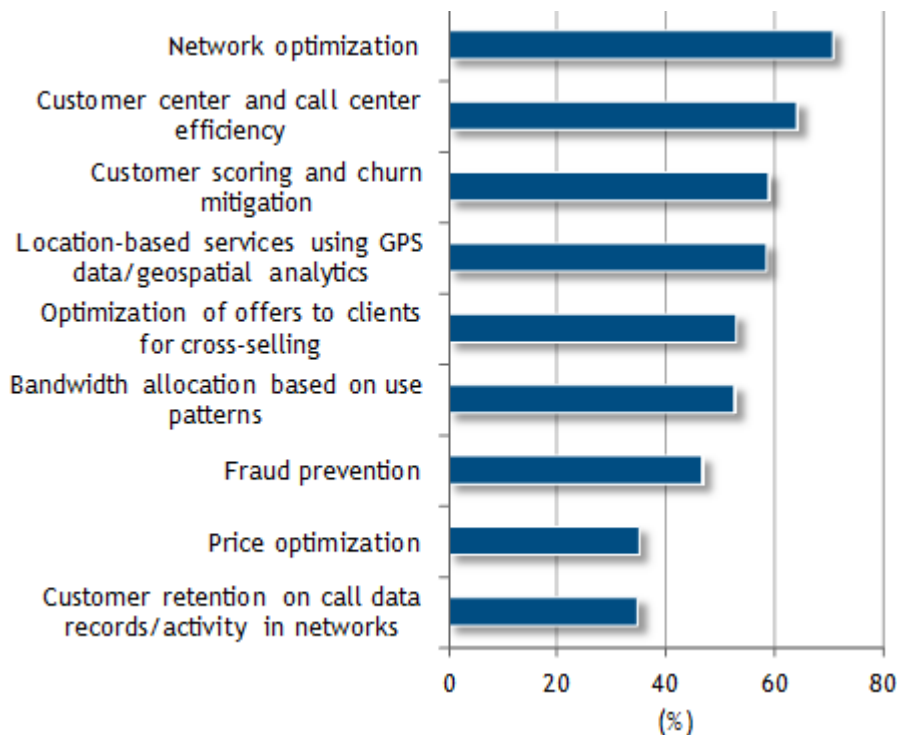
Number of Active Enterprises in Ireland 2011 586 (Source Eurostat)

Table 23: Communications & Media Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	233	250	263	274	282	282	283
Packaged Software	40	41	43	45	47	49	51
IT services	81	80	82	85	87	89	91

Source: IDC 2014

Figure 10: Telecommunications Sector Big Data Initiatives in Western Europe



Source: IDC 2014

Telcos are among the forerunners for Big Data adoption. Current adoption (have at least one Big Data initiative underway) according to our survey is nearly 63%, with an additional 4% of respondents planning to adopt a Big Data solution within two years. In this sector (Figure 10), network optimization is certainly the most sought-after use of Big Data, followed by customer

center and call center efficiency, reflecting the strong focus on improving productivity and reducing operational costs that characterizes the sector.

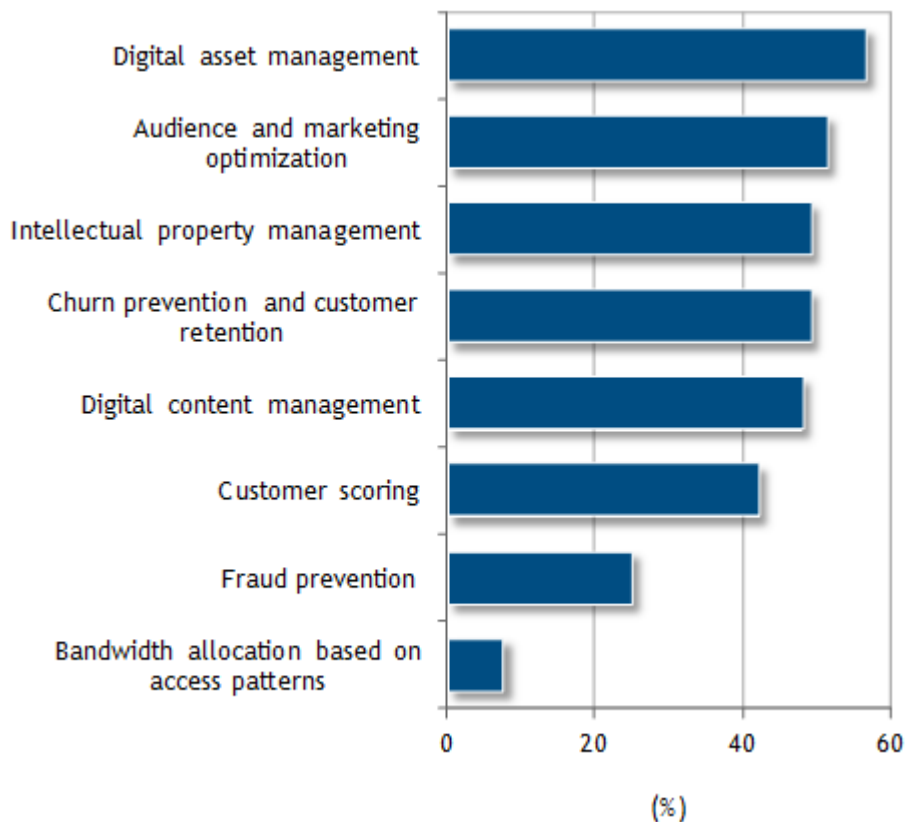
However, most of the other use cases that reached over 50% of mentions – customer scoring and churn mitigation, location-based services using GPS data and geospatial analytics, optimization of offers to clients for cross-selling, bandwidth allocation based on use patterns – are related to customer care and services improvement to better retention and cross-selling opportunities, reflecting the strong business priority assigned to customer-centered activities, driven by the need for better customer retention and profitability in the sector. Fraud prevention is also a relatively hot area for Big Data, while Big Data is relatively less used for price optimization and customer retention based on call data records and activity in subscribers' networks.

Media

Number of Active Enterprises in Ireland 2011 – 2900 (Source Eurostat)

Media IT spend is included in the Communications sector spend in Table 5 above

Figure 11: Media Sector Big Data Initiatives in Western Europe



Source: IDC 2014

The media sector is a little behind compared with telecom in Big Data adoption, but it caught up significantly over the past year. Around 40% of companies have already adopted a Big Data solution. A further 3% are planning to invest within the next two years, while most are still undecided. Digital asset management is the most used application leveraging Big Data in this sector (Figure 11), with very high adoption in the film production and radio and TV broadcasting subsectors, while the most common use case in the printing and publishing subsector is digital content management. The other related application, intellectual property management, also scores high across media subsectors. A number of applications follow, which reflect a strong focus on sales performance

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

improvement and customer care, such as audience and marketing optimization, churn prevention and customer retention, and customer scoring. Big Data is only used by a minority of companies for fraud prevention or for bandwidth allocation based on access patterns for video, music, and game software streams.

Financial Services

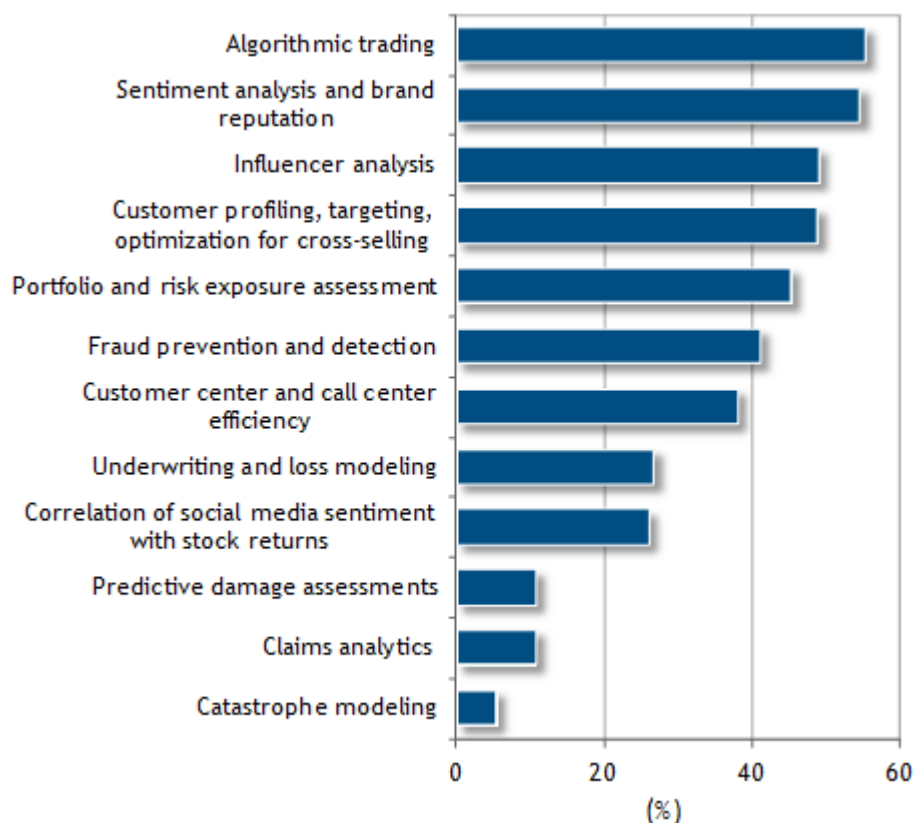
Number of Active Enterprises in Ireland 2011 5454 (Source Eurostat)

Table 24: Financial Services Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	181	182	182	191	199	205	209
Packaged Software	152	156	160	165	171	178	185
IT services	500	496	512	529	545	559	570

Source: IDC 2014

Figure 12: Financial Services Sector Big Data Initiatives in Western Europe



Source: IDC 2014

Financial Services is among the sectors in which data explosion is most likely to trigger action. The current adoption of Big Data solutions is high (28.2%), and short-term plans are strong (11.9%), particularly in the banking and other finance subsectors. Algorithmic trading and sentiment analysis and brand reputation are the two most used applications for Big Data in the financial services sector overall (Figure 12). Insurance companies are even more focused on specific applications,

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

particularly on predictive damage assessments and claims analytics, which are used by over 50% of insurance companies, although they represent a small share of the total financial services sector. Big Data is also used for influencer analysis; customer profiling, targeting, and optimization of offers for cross-selling (leveraging transactional data and unstructured social media feeds); portfolio and risk exposure assessment; and fraud prevention and detection by 40%-50% of financial companies and a slightly lower percentage of respondents for customer center and call center efficiency. Other applications, such as catastrophe modelling in insurance, underwriting and loss modelling in banking and other finance, or the correlation of social media sentiment with stock returns to support investment decisions are significantly less widespread.

Utilities

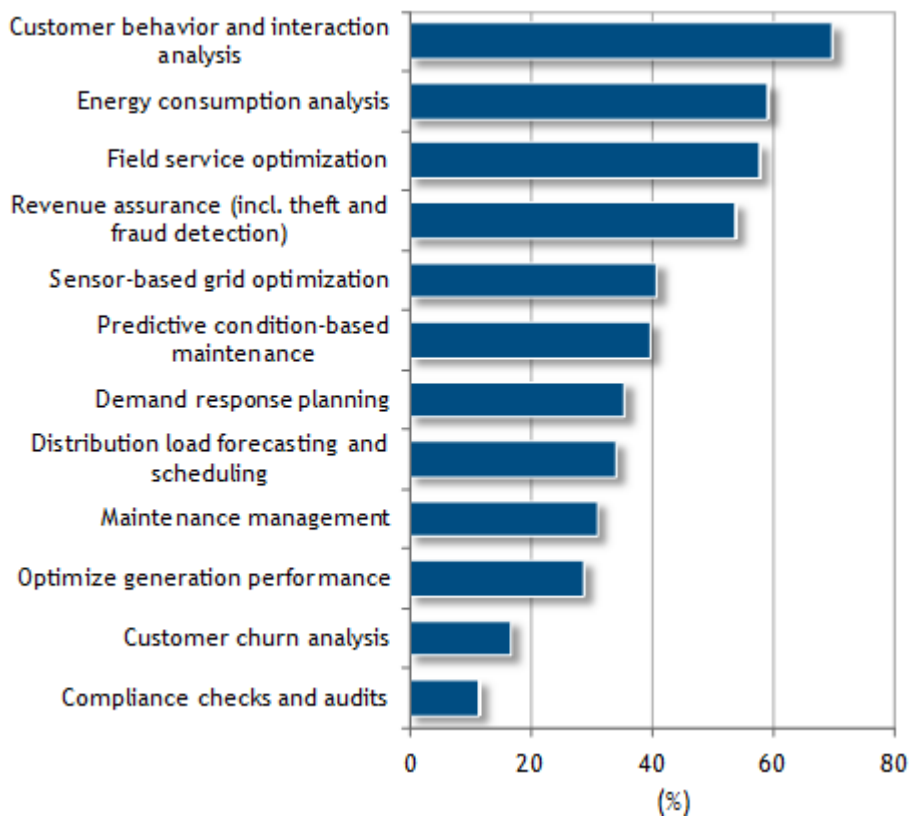
Number of Active Enterprises in Ireland 2011 1178 (Source Eurostat)

Table 25: Utilities Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	21	23	23	25	27	30	32
Packaged Software	6	6	7	7	7	8	8
IT services	33	34	36	37	38	40	41

Source: IDC 2014

Figure 13: Utilities Sector Big Data Initiatives in Western Europe



Source: IDC 2014

The energy sector is also among the forerunners in analytics adoption, at least in some subsegments, driven by an exponential increase in available data, with the introduction of smart meters and digital sensors and by the strong potential impact of better data usage on business performance. The adoption of Big Data is relatively widespread among larger utilities. Utilities companies (Figure 13) use Big Data solutions extensively for a number of key applications across their value chains to improve the overall productivity and profitability of their operations. The most popular use case is customer behaviour and interaction analysis (70% of adopters), but energy consumption analysis and field service optimization are also used by nearly 60% of respondents. Revenue assurance (including theft and fraud detection) follows close. Big Data is also used for a number of internal plant- and grid-related applications by 30%-40% of adopters in this sector. These use cases include sensor-based grid optimization, predictive condition-based maintenance, demand response planning, distribution load forecasting and scheduling, maintenance management, and generation performance optimization. Customer churn analysis and compliance checks and audits were only mentioned by a minority of Big Data adopters

Oil and Gas

Number of Active Enterprises in Ireland 2011 354 (Source Eurostat)

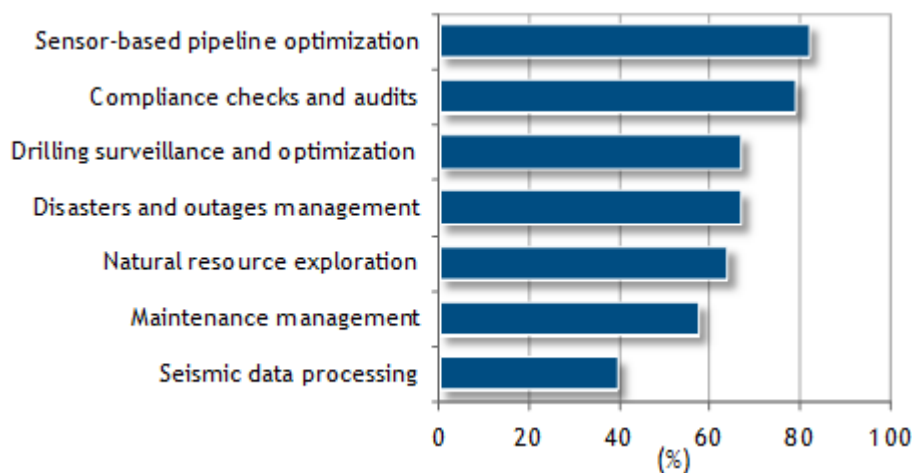
Table 26: Agriculture, Construction & Mining Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	16	16	16	17	17	17	17
Packaged Software	17	18	19	19	20	21	22
IT services	33	33	33	34	34	34	34

Source: IDC 2014

Oil and gas Extraction is included in the above IT spending data and the associated Big Data initiatives are in the chart below. Spend relating to refining activity is included in the Manufacturing figures below and similarly for distribution, the spend is in the Utilities numbers.

Figure 14: Oil & Gas Sector Big Data Initiatives in Western Europe



Source: IDC 2014

The adoption of Big Data technologies is relatively widespread in the oil and gas sector, reaching nearly 30% according to our survey, with a good share of companies planning to adopt in the next two years. A large majority of oil and gas companies (Figure 14) adopting or planning to adopt Big Data solutions use them for sensor-based pipeline optimization and compliance checks and audits (around 80%). 60% or more use them for drilling surveillance and optimization, disasters and outages management, natural resource exploration, or maintenance management, while around 40% use them for seismic data processing.

Retail/Wholesale

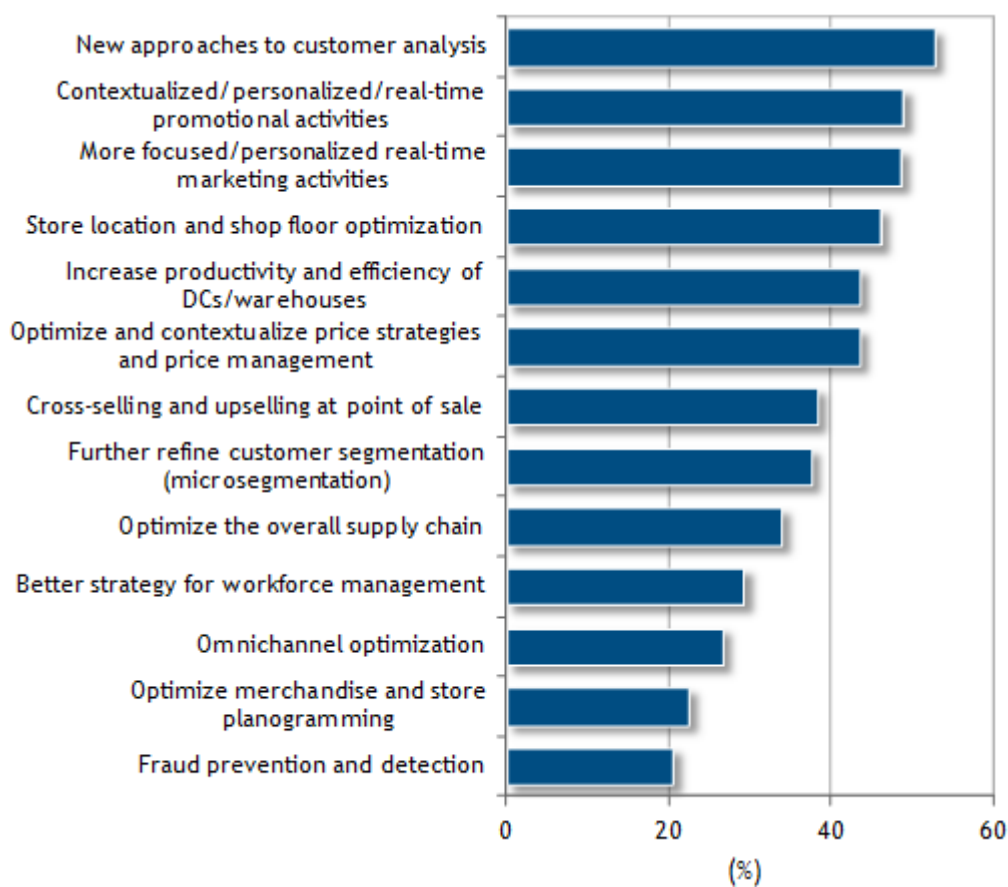
Number of Active Enterprises in Ireland 2011 42,966 (Source Eurostat)

Table 27: Retail/Wholesale Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	89	93	92	96	100	102	104
Packaged Software	80	83	85	87	90	93	97
IT services	169	168	171	174	177	179	180

Source: IDC 2014

Figure 15: Retail/Wholesale Sector Big Data Initiatives in Western Europe



Source: IDC 2014

Retail/wholesale companies overall are relatively close to the market average in terms of adoption (22.6% overall) and above average in terms of plans (8.6%) for Big Data solutions, with much higher adoption among large retailers and wholesalers and stronger plans among SMBs. The most common use cases in retail/wholesale (Figure 15) are unsurprisingly very focused on customers, with 54% of respondents indicating they use or will use Big Data to introduce within the company's new approaches around customer analysis (e.g., use of video analytics, social media data, heat maps), and around 49% aiming to develop contextualized/personalized/real-time promotional activities (personalized coupons/in-store discounts) or sustain more focused and/or personalized real-time marketing activities. Some internal optimization and productivity improvement areas are also

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

popular use cases, from store location and shop floor optimization to the productivity and efficiency of distribution centers and warehouses. Big Data is also used by a good share of retailers to optimize and contextualize price strategies and price management for cross-selling and upselling at the point of sale and for micro-segmentation to further refine customer segmentation to make it more granular.

Manufacturing

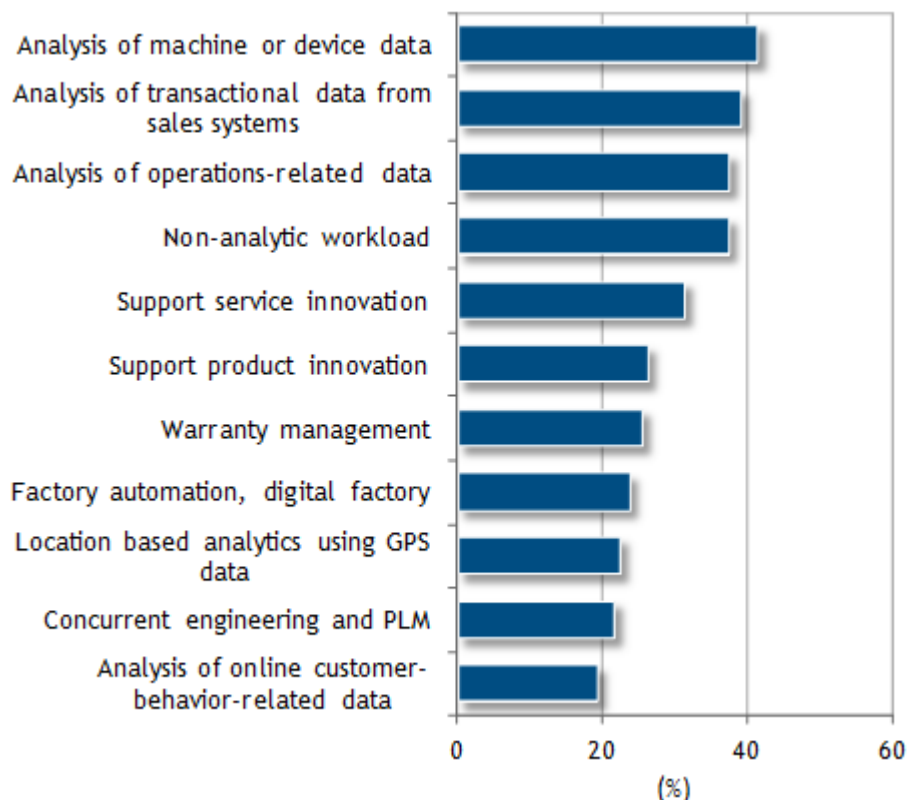
Number of Active Enterprises in Ireland 2011 12,290 (Source Eurostat)

Table 28: Manufacturing Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	222	230	229	241	251	258	263
Packaged Software	125	131	135	140	146	152	157
IT services	284	287	295	303	311	316	320

Source: IDC 2014

Figure 16: Manufacturing Sector Big Data Initiatives in Western Europe



Source: IDC 2014

Manufacturing subsectors revealed striking differences among them both in terms of attitude to data growth and adoption of Big Data technologies. Overall, discrete manufacturing is ahead of the game in terms of adoption (24.6%) and short-term plans (9.7%), while process manufacturing

HARNESSING BIG DATA FOR INNOVATION LED GROWTH: AN ASSESSMENT OF IRELAND'S PROGRESS AND FURTHER POLICY REQUIREMENTS

appears as a laggard with only 16.2% of current adopters and 6.5% planning to adopt. In the aggregated manufacturing sector (Figure 16), there is a strong focus on improving productivity and reducing operational costs, and Big Data can help manufacturers to achieve these goals. Four broad application areas appear as prevalent in terms of use (37%-41% of respondents): the analysis of machine or device data (e.g., equipment, products, radio frequency identification or RFID, buildings, other sensors), the analysis of transactional data from sales systems, the analysis of operations-related data (e.g., quality, maintenance, fast manufacturing resource planning or MRP), and non-analytic workload such as use of Big Data technology (e.g., NoSQL Database or Hadoop) to run online transaction processing (OLTP) systems, websites, or email applications. Big Data is also quite widely used for support- and warranty-related applications (25%-31% of respondents), while other applications are less popular overall, with less than a quarter of adopters mentioning them. However, there are differences across subsectors, particularly between adopters in discrete and process manufacturing. Discrete manufacturers are more inclined to use Big Data for non-analytic workload among the top 4 use cases, and they are also more likely to use Big Data to support service innovation (new service delivery models) for warranty management and for factory automation/digital factory for lean manufacturing. Process manufacturers on the other hand are more inclined to use Big Data for the analysis of machine or device data or the analysis of operations-related data and to support product innovation (e.g., 3D search and part reuse, crowdsourcing) and location-based analytics based on GPS data.

Professional Services

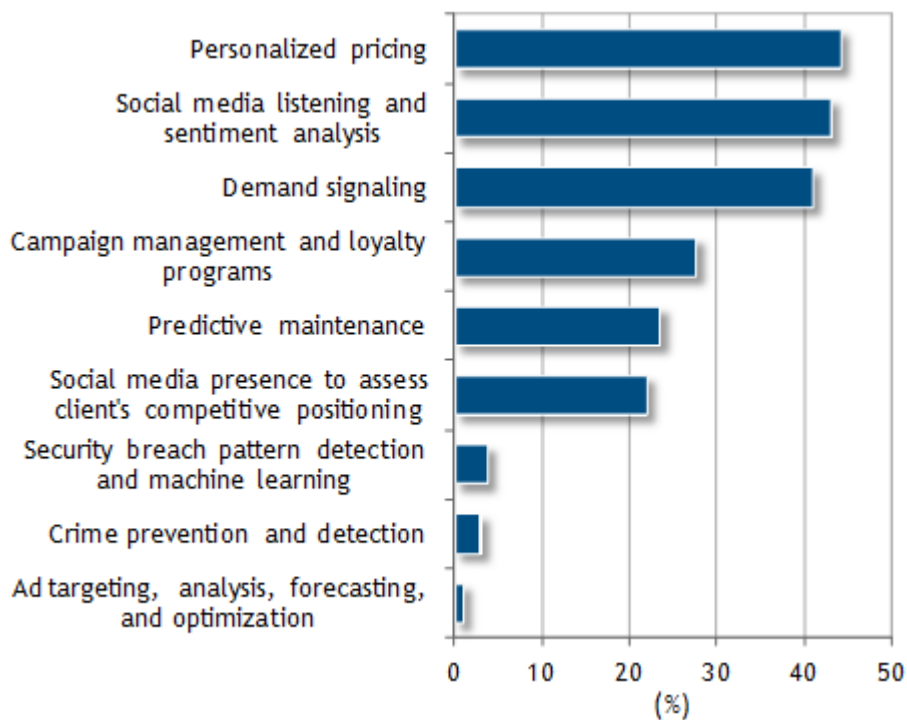
Number of Active Enterprises in Ireland 2011 30,440 (Source Eurostat)

Table 29: Professional Services Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	74	76	77	80	82	83	83
Packaged Software	84	87	90	93	98	102	107
IT services	139	139	143	148	152	156	159

Source: IDC 2014

Figure 17: Professional Services Sector Big Data Initiatives in Western Europe



Source: IDC 2014

The professional services sector lags in Big Data technology adoption, with below-average near-term plans. However, there are large variations across subsectors with software and IT services companies showing much higher penetration of Big Data technologies, followed by audit and tax, consulting, and legal. The most popular use cases in the aggregate professional services vertical market (Figure 17) appear in line with two of the sector's key business priorities, improving productivity and customer care enhancement. Overall, Big Data is used by most adopters for personalized pricing – particularly in advertising, staffing, and other services – social media listening and sentiment analysis, and for demand signalling. Campaign and loyalty programs, predictive maintenance, and social media presence to assess clients' competitive positioning are also relatively used across the industry. Other applications are common only within specific subsectors in this very diverse and fragmented vertical market, such as crime prevention and detection among security services companies or ad targeting, analysis, forecasting, and optimization among advertising companies.

Transport

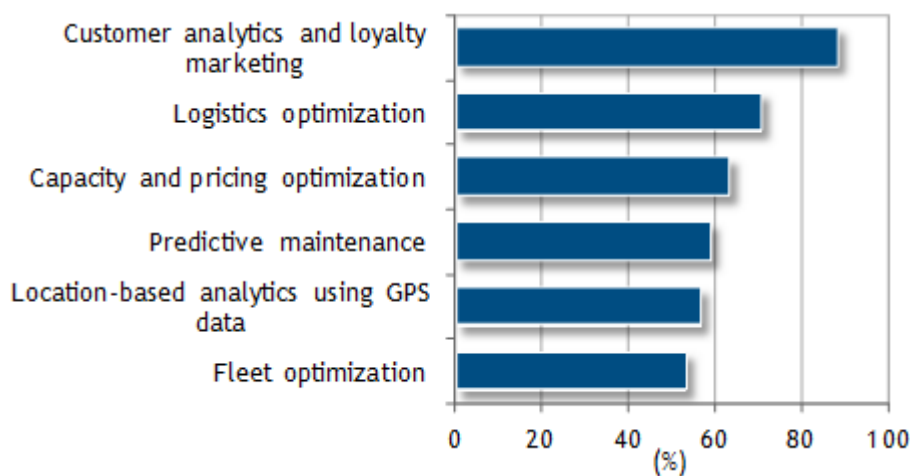
Number of Active Enterprises in Ireland 2011 10,171 (Source Eurostat)

Table 30: Transport Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	27	28	28	29	30	31	31
Packaged Software	28	29	29	30	31	33	34
IT services	59	58	59	61	62	63	63

Source: IDC 2014

Figure 18: Transport Sector Big Data Initiatives in Western Europe



Source: IDC 2014

Transport companies are lagging in the current adoption of Big Data technologies, but penetration in some subsectors (such as airlines) is well above average. Overall, the sector is set to catch up and get ahead of the game within the next two years as over 11% of respondents revealed adoption plans. Big Data is used by a very large share of adopters in the transport sector for analytics and loyalty marketing (Figure 18), which is understandable in a sector where low-cost competition triggered a strong focus on improving sales and service innovation to retain clients and improve their profitability. Logistics optimization and capacity and pricing optimization are the two other most popular use cases, but a number of other application areas, mainly related to productivity improvements, also attracted over 50% of mentions from predictive maintenance to location-based analytics using GPS data and fleet optimization

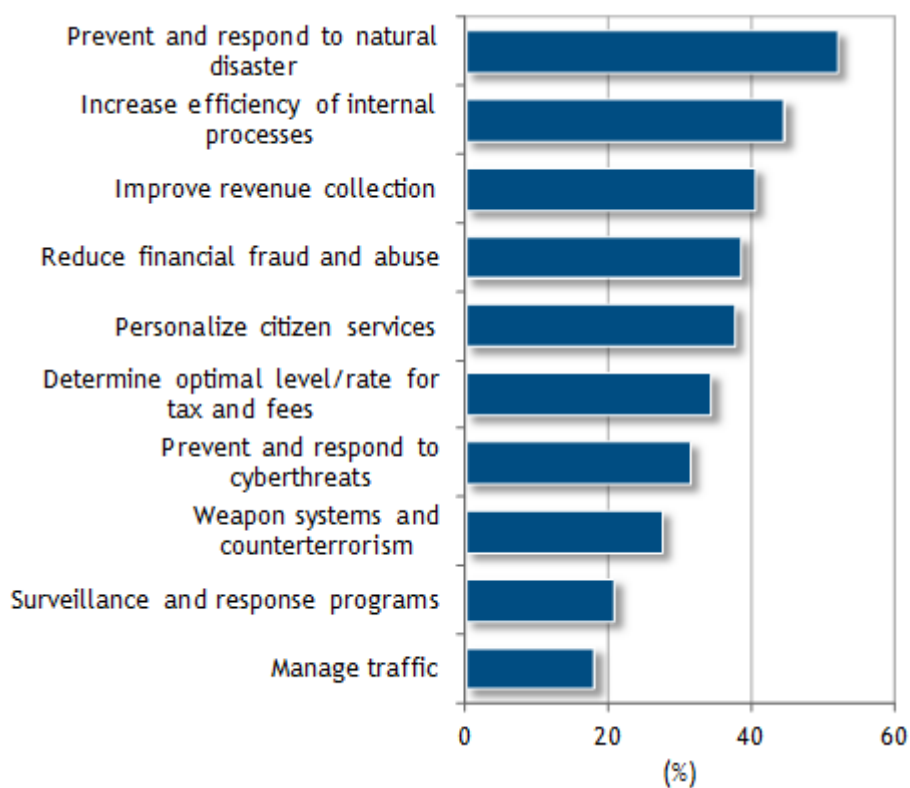
Government

Table 31: Government Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	111	110	109	112	113	113	112
Packaged Software	127	130	134	137	143	148	154
IT services	334	329	332	334	342	347	350

Source: IDC 2014

Figure 19: Government Sector Big Data Initiatives in Western Europe



Source: IDC 2014

The public sector overall across most subsectors would be one of the biggest beneficiaries of Big Data technologies. However, both current adoption (17.4%) and short-term plans (4.7%) are still low partly due to lack of budget and the long and cumbersome decision-making processes that characterize public sector organizations. In the government sector (Figure 19), Big Data is used primarily, particularly at local level, to prevent and respond to natural disasters and to increase the efficiency of internal processes. The other key use cases are related to tax collection – improve revenue collection, reduce financial fraud and abuse, and determine optimal level/rate for tax and fees – and the personalization of citizen services. Defence- and security-related applications as well as traffic management of Big Data are less widespread, being linked to specific government agencies and local organizations.

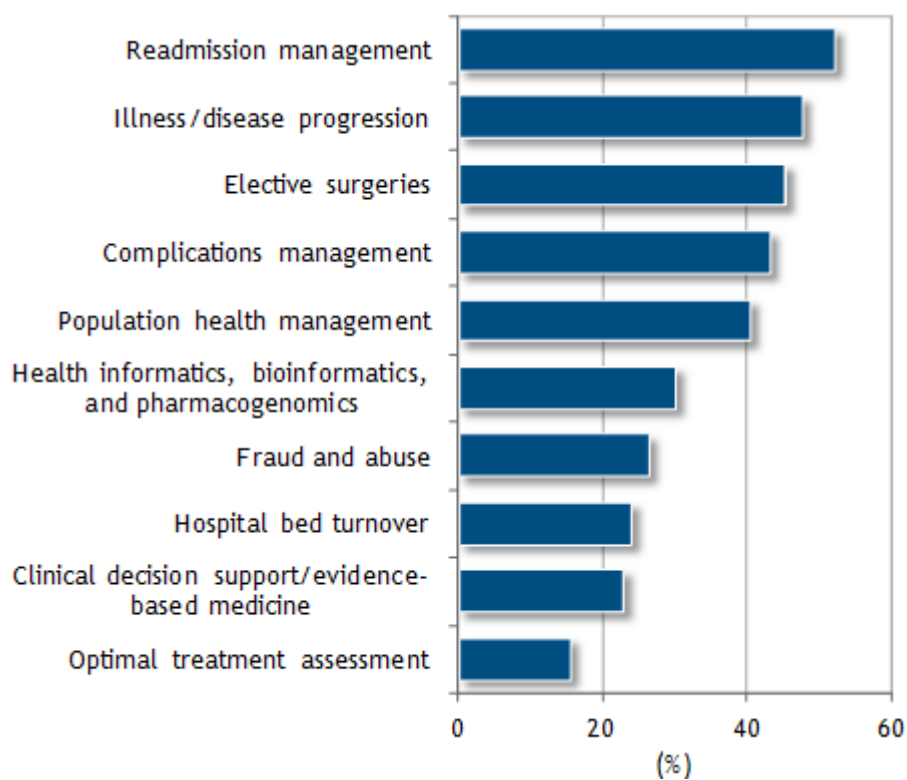
Healthcare

Table 32: Healthcare Sector IT Spend in Ireland 2012-2018

\$m	2012	2013	2014	2015	2016	2017	2018
Hardware	48	50	50	52	53	54	55
Packaged Software	46	48	50	52	54	57	59
IT services	80	81	84	87	89	91	92

Source: IDC 2014

Figure 20: Healthcare Sector Big Data Initiatives in Western Europe



Source: IDC 2014

Healthcare shows better prospects for the near future with 10.2% of respondents planning to adopt a solution within the next two years, although current adoption is slightly lower than in government at 16.5%. In this sector (Figure 20), Big Data solutions are used by the largest share of adopters for readmission management (e.g., predicting readmission at the point of original admission) and to assess illness or disease progression (e.g., risk score of likelihood to suffer from hospital-acquired infections, causal factors of illness/disease progression, identification of possible co-morbid conditions). Three other use cases are also relatively widespread: elective surgeries (e.g., identify patients who will likely choose elective surgeries), complications management (e.g., identify patients at risk for medical complications), and population health management. Other applications were selected by 30% or less of Big Data adopters in the sector.

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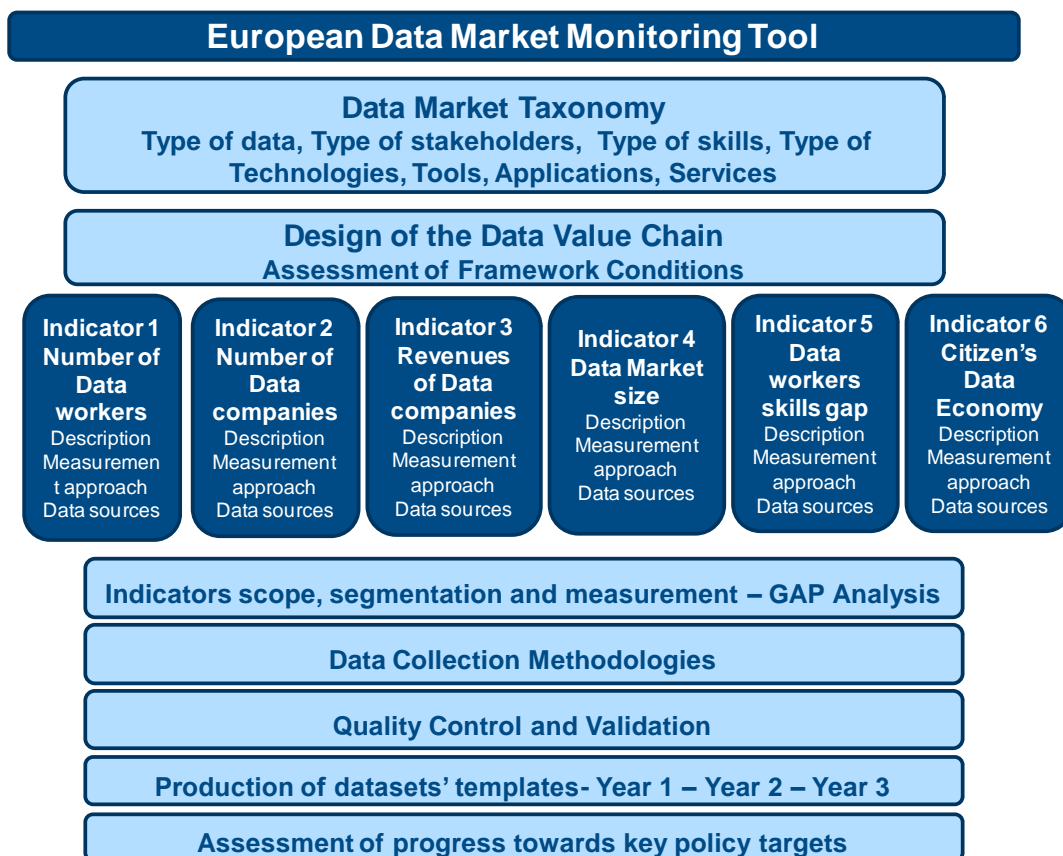
Annex C - European Data Market Study

The main goal of the Study “European Data Market SMART 2013/0063” entrusted to IDC and Open Evidence by the European Commission DG Connect, is to define, assess and measure the European data economy with the aim to support the EC’s Data Value Chain policy. The specific objectives are:

- **Objective A:** The development of a European Data Market Monitoring Tool providing facts and figures on market size and trends;
- **Objective B:** The collection and production of descriptive stories about the European data economy including quantitative facts and figures;
- **Objective C:** Building a community of relevant stakeholders in the EU to deep internal connections among existing communities and reach out to different and new stakeholders.

The main indicators to be measured are presented in the Figure below. The definitions of data companies and data user companies are presented in Annex D and are based on the study taxonomy.

Figure 21: The European Data Market Monitoring Tool



Annex D - Taxonomy

Data-related Companies

Key term	Definition
Data Companies	Data companies are data suppliers, meaning that their main activity is the production and delivery of data-related products, services and technologies. These companies constitute the emerging data industry. Data companies may be start-ups, innovative SMEs, spin-offs of larger enterprises. Most of them originate from, or are currently classified within the ICT industry, because the core technology they use is Big Data technology.

Data Users

Key term	Definition
Data Users	Data users are organisations with high intensity of reliance on data for the accomplishment of their mission: this means that they generate and exploit their own data, collect online customer data intensively, subject this data to sophisticated analyses (such as controlled trials and data and text mining), and use what they learn to improve their business.

Key terms	Definition
Data	Data is usually defined as qualitative or quantitative statements or information which can be coded and which are assumed to be factual and not the product of analysis or interpretation. For the sake of this study we consider only data which is collected, processed, stored, and transmitted over digital information infrastructures and/or elaborated with digital technologies. This definition includes multimedia objects which are collected, stored, processed, elaborated and delivered for exploitation through digital technologies (for example, images databases).
Information	Information is the output of processes that summarise, interpret or otherwise represent the content of a message to convey meaning. Therefore information is not a mere synonymous of data.

Data Economy and Data Market

Key terms	Definition
Data Market	The data market is the market where digital data is exchanged as "products" or as "services" derived from raw data. The exploitation of the exchanged data enables a better understanding of the environment, and helps improving existing services, increasing efficiency, and eventually launching new products/services also in the more traditional sectors of the economy (such as manufacturing, transport or retail).
Data Economy	The data economy involves the generation, collection, storage, processing, distribution, analysis, elaboration, delivery and exploitation of data enabled by digital technologies. The data economy includes also the direct, indirect and induced effects of the data market on the economy.