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ICT-SECTOR
IN IERLAND

FLANDERS INVESTMENT & TRADE MARKTSTUDIE

ICT-Sector in Ireland

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Content

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1 Preface

By nature, the ICT-sector is a quickly changing environment, wherein evolutions and revolutions are following each other in rapid succession. This market study will therefore focus mainly on the newer branches of the sector. Sectors like hardware and software remain to be a vital part of the ICT-sector in Ireland, but given their well-established status, we deem it more interesting to focus on the new players in the sector with high growth potential and where opportunities lay for our Flemish companies.

First of all, Ireland is an ideal place for ICT-development. Figures from 2015 show that the Irish economy is growing again at an annual rate of 7.8%. Many multinationals have chosen Ireland as their location due to the favourable tax regime, highly skilled workforce, and for being an English-speaking country within the European Union. The Irish start-up scene is also very vibrant due to many governmental support schemes, mostly in terms of finance and information.

This report will focus on the new ICT sectors:
- Social media
- Mobile applications
- Cloud computing
- Microelectronics
- Internet of Things (IoT)
- E-commerce
- Games
- AR, VR & MR

All these innovations couldn't take place without the proper research and development. Ireland houses a vast amount of state-of-the-art public and private R&D-centres which we focus on in the second part of this study.

To conclude, this report provides a directory of key associations and organisations involved in the Irish ICT-sector as well as a directory of the main events in Ireland on ICT.

For Flemish companies active in the ICT-sector, Ireland can be an interesting market to establishing partnerships or to sell their own products or services. With this study we try to give an overview of new developments in the Irish ICT-sector, in order to provide Flemish companies with an initial introduction.

For further information or assistance in approaching the Irish market, feel free to contact the local office of Flanders Investment and Trade in your province or the FIT office in Dublin.

Flanders Investment and Trade

Dublin, December 2016

2   The Irish Economy

The Irish economy is recovering from the economic crash in 2008. The weekly economical editorial *The Economist* even mentions the term *Celtic Phoenix* in their November 2015 edition, referring to the term *Celtic Tiger* used for the thriving Irish economy in the period 1995-2007.[1] Unemployment dropped to a level of 7.9% in the summer of 2016, compared to 15% at the beginning of 2012, and forecasts are that the level of unemployment will keep dropping in the coming years. In addition to this declining unemployment there is also a prominent, positive trend in other economic indicators. Consumers spent up to 3.5% more in 2015 compared to 2014 and this trend seems set to continue. A strong economic growth of 7.8% was noted in 2015. However, forecasts from the International Monetary Fund predict economic growth will drop to 2.8% in 2019, this remains however notably higher than the expected economic growth of 1.3% in Belgium in the same year.[2]

Not to be forgotten is that, given the close economic links of the Republic of Ireland with the United Kingdom, a big question mark needs to be put on what the impact will be of the impending Brexit on the Irish economy.

ii | Quarterly Economic Commentary – Summer 2016

Summary Table

	2013	2014	2015	2016	2017
Output (Real Annual Growth %)					
Private Consumer Expenditure	-0.3	2.0	3.5	4.0	3.5
Public Net Current Expenditure	1.4	4.6	-0.8	1.0	1.0
Investment	-6.6	14.3	28.2	21.1	21.9
Exports	2.5	12.1	13.8	8.9	7.9
Imports	0.0	14.7	16.3	12.0	11.9
Gross Domestic Product (GDP)	1.4	5.2	7.8	4.6	4.2
Gross National Product (GNP)	4.6	6.9	5.7	4.8	4.3
Prices (Annual Growth %)					
Consumer Price Index (CPI)	0.5	0.2	-0.3	0.8	1.0
Growth in Average Hourly Earnings	-0.8	1.6	2.0	2.3	2.3
Labour Market					
Employment Levels (ILO basis (000s))	1,880	1,914	1,964	2,009	2,046
Unemployment Levels (ILO basis (000s))	282	243	204	172	152
Unemployment Rate (as % of Labour Force)	13.1	11.3	9.5	7.9	6.9
Public Finance					
General Government Balance (€ bn)	-10.2	-7.6	-4.9	-2.3	-0.2
General Government Balance (% of GDP)	-5.8	-4.1	-2.3	-1.0	-0.1
General Government Debt (% of GDP)	123.2	109.7	93.6	86.4	80.2
External Trade					
Balance of Payments Current Account (€ bn)	5.6	6.8	9.5	11.0	6.8
Current Account (% of GNP)	3.1	3.6	4.4	4.8	2.7
Demand					
Final Demand	0.9	9.4	11.9	8.3	8.3
Domestic Demand	-1.2	5.7	9.3	7.5	8.9
Domestic Demand (excl. Stocks)	-1.5	5.2	8.6	8.3	8.9

Source: Quarterly Economic Commentary, Summer 2016 - The Economic and Social Research Institute.[3]

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[1] *Celtic Phoenix - The Economist (www.economist.com/news/finance-and-economics)*
[2] *World Economic Outlook April 2016 - International Monetary Fund (www.imf.org/external/pubs/ft/weo/2016/01/weodata/weoselser.aspx?c=178&t=1)*
[3] *Quarterly Economic Commentary, Summer 2016 - The Economic and Social Research Institute (www.esri.ie/pubs/QEC2016SUM.pdf)*

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3 ICT-sector

When we take a look at the list of the top 15 ICT-companies in the world, established by the Fortune Global 500 and ranked on profits, we notice that bare one, 14 out of 15 have offices, manufacturing plants or R&D-facilities in Ireland.[4]

Name	HQ	Ireland	Sector
Apple	USA	Cork	Hardware
Samsung Electronics	South Korea	Dublin	Hardware
Hon Hai Precision Industry	Taiwan	/	Hardware
Amazon.com	USA	Dublin	Internet
HP	USA	Leixlip	Hardware
Microsoft	USA	Dublin	Software
IBM	USA	Dublin + Galway + Cork	IT
Alphabet	USA	Dublin	Internet
Sony	Japan	Dublin	Hardware
Panasonic	Japan	Dublin	Hardware
Huawei Investment & Holding	China	Dublin	Hardware
Intel	USA	Leixlip + Shannon	Semiconductor
LG Electronics	South Korea	Dublin	Hardware
Cisco Systems	USA	Dublin + Galway	IT
Lenovo Group	China	Dublin	Hardware

Source: Fortune 2016 Global 500 Technology – Fortune

There are multiple reasons why Ireland is an interesting place for big, global companies. The low corporate tax of 12.5% is definitely an important aspect.[5] For start-ups there is a broad variety of programmes available to participate in, lots of them are offered by Enterprise Ireland, IDA Ireland, Start-up Ireland and many other organisations or private companies. Furthermore, it is of importance, especially for American companies, that Ireland is an English-speaking country within the European Union. The quality and number of the available workforce also attracts foreign businesses. Furthermore, the extensive network of R&D facilities within Irish Institutes of Technology and large companies is important to attract IT-companies.

The following figures give an idea of the size of the ICT-sector in Ireland:[6]

- *Computer, Computer parts & Storage Devices* holds 7th place in the top 20 of export commodities. It comprises € 4,198 million, 4% of the total exports of goods.
- *Computer Services* holds the number one spot in the top 20 of export services, with a share of 48%, representing € 56,267 million.
- *Information, Communication & Computer Services* delivered 88,097 direct jobs in 2015, a notable increase compared to 63,350 jobs in 2006. The total Irish ICT-sector (including

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[4] *Fortune 2016 Global 500 Technology – Fortune (www.beta.fortune.com/global500/list/filtered?sector=Technology)*
[5] *Doing Business in Ireland – Word Bank (www.doingbusiness.org/data/exploreeconomies/ireland)*
[6] *Ireland's Trade Performance - Department of Jobs, Enterprise and Innovation (www.djei.ie/en/Publications/Publication-files/Summary-of-Ireland-s-Trade-Performance.pdf)*

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production facilities) employs directly 105,000 people, of whom 25% work in Irish enterprises and 75% in multinationals.[7]

ICT Ireland makes the following statement about the presence of technological companies in Ireland:

- *10 of the top 10 global technology companies*
- *9 of the 10 global software companies*
- *5 of the 5 top security software companies*
- *3 of the top 3 enterprise software companies*
- *3 of the top 5 games companies*
- *4 of the top 5 IT services companies*
- *The top 10 'born on the internet' companies[8]*

3.1   New sectors

In the last few years Ireland's ICT-sector has seen some significant changes. Traditionally, multinationals in Ireland were mainly active in hardware production and related services. In line with the global trend, the competition with low-wage countries got fiercer. One of the most striking examples was the delocalisation of the Dell-factory to Poland in 2009, losing 1,900 direct jobs in Ireland.[9] The remaining hardware sector focuses on advanced production processes in the areas of microelectronics, semiconductor and telecommunication equipment. Concerning Support Services, Ireland seemed to be quite resilient to the global trend due to low tax rates, highly-educated staff, a beneficial time zone and the convenient access to the EMEA (Europe, Middle East, Africa). However, competition with countries like India has also risen in this part of the sector, creating the need to focus on new innovations in Ireland.

Many Irish companies are active in the software sector. This sector is still very big, but a big revolution is taking place, with the rise of mobile applications. An article from the Irish independent states: "Large-screen iPhones and Android handsets are causing people to ditch their desktop and laptop computers for all but office-related use, the figures indicate." This is a global trend, which is deploying rapidly in Ireland.[10]

The last few years some new sectors arose in world of ICT. One of them is **social media**, of which the main players (Facebook, Twitter, Google, LinkedIn) have located their European HQ in Ireland. The country plays a leading role in the adaptation and integration of social media. According to the statistics, 64% of Irish businesses use social media, compared to 39% of businesses in the EU-28.[11]

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[7] *Annual Employment Survey 2015 - Department of Jobs, Enterprise and Innovation*
(www.djei.ie/en/Publications/Publication-files/Annual-Employment-Survey-2015.pdf)
[8] *Sector Profile - ICT Ireland*
(www.ictireland.ie/Sectors/ICT/ICT.nsf/vPages/Papers_and_Sector_Data~sector-profile?OpenDocument)
[9] *1,900 lost at Dell in Limerick – RTE (www.rte.ie/news/2009/0108/112419-dell)*
[10] *Irish mobile phone usage highest in the western world, global stats reveal – The Irish Independent*
(www.independent.ie/business/technology/irish-mobile-phone-usage-highest-in-the-western-world-global-stats-reveal-31480385.html)
[11] *Social Media - Information Society Statistics, Enterprises 2015 – Central Statistics Office*
(www.cso.ie/en/releasesandpublications/er/iss/informationsocietystatistics-enterprises2015)

Furthermore, **cloud computing** is gaining ground. In 2015, 35% of Irish enterprises bought a cloud computing service, compared to 28% in 2014.[12]

Linked to cloud computing is the emergence of the **Internet of Things**, or simply IoT. This form of artificial intelligence is able to analyse data from the cloud, or other databases, and learn from it. This creates insights that the human brain can't possibly think off. Research on IoT is conducted on a very high level in Ireland, for instance by IBM in the IBM Technology Campus and in the Tyndall National Institute in Dublin. ICT Ireland has also set up a focus group for IoT.[13]

These systems obviously cannot exist without the right technical equipment, which is also developed in Ireland. **Micro-electronics** is a growing industry in Ireland, which currently employs over 8,000 people. There is a dynamic cooperation with research institutes and the Institutes of Technology.[14]

Today, **E-commerce** in which products or services are sold through electronic channels is indispensable. With the rise of e-commerce, the development of e-payments also accelerated. Fintechs and other ICT-companies are strongly investing in this. A striking statistic, that shows the size of e-commerce, 70% of large Irish companies bought something online in 2015 and 50% of their sales were made via e-commerce.[15]

The **gaming industry** is likewise an important sector in Ireland, some of the biggest developers have a branch in Ireland.[16] **Augmented & Virtual Reality** industry has close ties with the gaming sector, given the possible applications and innovations collaboration can deliver.[17]

In the following chapters, we will examine these sectors in more detail.

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[12] *Cloud Computing Services - Information Society Statistics, Enterprises 2015 – Central Statistics Office (www.cso.ie/en/releasesandpublications/er/iss/informationsocietystatistics-enterprises2015)*
[13] *Internet of Things (IoT) – ICT Ireland (www.ictireland.ie/Sectors/ICT/ICT.nsf/vPages/Policy_Groups~internet-of-things-(iot)?OpenDocument)*
[14] *Dublin conference to examine future of Irish microelectronics sector – Digital Daily (www.digitaldaily.ie/2015/11/24/dublin-conference-to-examine-future-of-irish-microelectronics-sector)*
[15] *E-commerce - Information Society Statistics, Enterprises 2015 – Central Statistics Office (www.cso.ie/en/releasesandpublications/er/iss/informationsocietystatistics-enterprises2015)*
[16] *A map of the Irish Games Industry – gamedevelopers.ie (www.gamedevelopers.ie/irish-games-industry-map)*
[17] *Spotlight on future of augmented and virtual reality at Dublin event – The Irish Times (www.irishtimes.com/business/technology/spotlight-on-future-of-augmented-and-virtual-reality-at-dublin-event-1.2620934)*

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3.2 Geographical spread

Dublin is the centre of the tech industry in Ireland. The world's largest ICT-companies have offices in Dublin, e.g. Samsung Electronics, Amazon, Microsoft, IBM, Alphabet, Sony, Panasonic, Huawei LG Electronics, Cisco Systems, Lenovo Group. Most of them are located around the Grand Canal Dock, also known as The Silicon Docks. Benefits are the proximity of an international airport, other multinational companies and start-ups for collaboration and the presence of excellent human asset flowing out of Trinity College Dublin, Dublin City University and University College Dublin. However, the cost and availability of housing in Dublin, forces many start-ups and newcomers to start in other parts of Ireland.
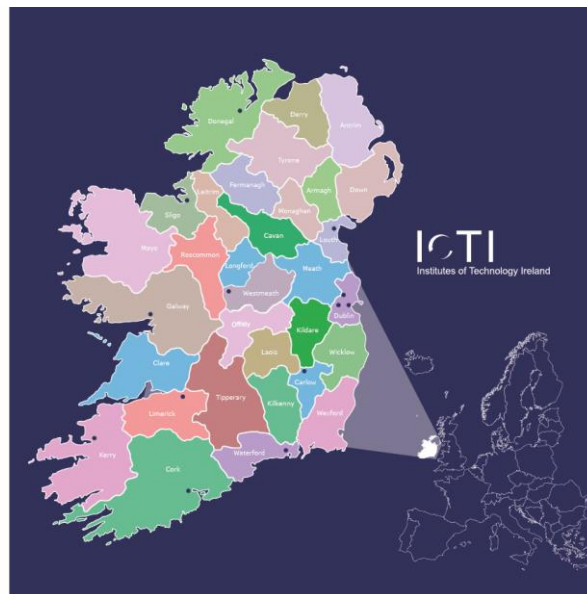
In the southern part of the country you can find multiple cities with a big presence of ICT-companies. **Cork** is the second largest city of Ireland and since the beginning the Irish homestead of Apple. **Waterford** is home to various R&D-centres and start-ups, often linked to the Waterford Institute of Technology.

In the west of Ireland (which is a vast area) there are three tech hubs. **Galway** is the fourth city of Ireland and has a vibrant start-up climate. Both city and county encourage entrepreneurship, and new industrial areas and R&D-centres are appearing everywhere. These are often linked to the Galway-Mayo Institute of Technology. **Limerick** also accommodates multiple research- and production facilities of multinationals. And finally, **Sligo** also is home to a large number of ICT-companies, mostly active in the software sector.

To sum up we can say most ICT-companies in Ireland are located in Dublin, due to beneficial circumstances. Daresay, there are other cities who are on the rise and invest in attracting ICT-companies. Ireland sometimes get referred to as the *tech hub of Europe*[18]. Most companies have strong ties with Irish universities and Institutes of Technology.

Source: Institutes of Technology in Ireland – Technological Higher Education Association Ireland[19]

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[18] *Ireland primed to become European tech hub – Irish Examiner*
(www.irishexaminer.com/business/ireland-primed-to-become-european-tech-hub-296033.html)
[19] *Institutes of Technology in Ireland – Technological Higher Education Association Ireland (www.thea.ie/about-us/about-us)*

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4 Rising ICT-sectors

4.1 Social media

Social media have quickly become part of our daily life, from their public introduction in early 21th century. They started to spread amongst young people, yet several social media are now being used by all age groups. Engagement by the users rises, with increased time spent per day on social media. Tumblr is the most engaging medium with an average daily use of 3 hours and 14 minutes.[20]

Account ownership on social media in Ireland	
Facebook	64%
LinkedIn	27%
Twitter	26%
Google+	26%
Instagram	23%
Pinterest	16%
Tinder	6%
Tumblr	4%

Source: Account ownership – Ipsos MRBI

Ipsos MRBI has published research about the ownership and usage of social media in Ireland in July 2016. Many of the social media are owned by American companies, who have their EMEA HQ in Dublin e.g. Facebook, Twitter, Google and LinkedIn. The data from Ipsos MRBI show that the number of account owners has stayed more or less stable since August 2014. The daily usage of Facebook is the highest, reaching 74%, closely followed by Instagram with 55%, and Twitter with 36%. In the table you can find the percentage of the Irish population that holds an account to each social medium.[21] The numbers point out social media are widely spread and commonly used in Ireland. Not only individuals, but enterprises as well are very willing to adopt social media. The use of social media by Irish enterprises is the second highest in the EU in 2015, with 64% of enterprises using some type of social media.[22]

Opportunities lie both in demand and supply:
- On the supply side, opportunities will be linked to the launch of new services and/or the establishment of new businesses offering social media related services/technologies.
- On the demand side, opportunities will be linked to the value generated processes companies across all markets.[23]

Many of the social media have introduced tools designed for business. They offer marketing packages for fairly low amounts of money. And since many people are active on them, you can reach a reasonable amount of Irish customers by targeted marketing campaigns. Some examples are:
- Facebook for Business
- LinkedIn Company Page
- Twitter for Business
- Google Small Business

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[20] *Daily time spent on all social media - Global Web Index blog (www.globalwebindex.net/blog/tumblr-users-spend-the-longest-social-networking)*
[21] *Account ownership – Ipsos MRBI (www.ipsosmrbi.com/wp-content/uploads/2016/08/Social-Networking-2016.pdf)*
[22] *Social Media - Information Society Statistics, Enterprises 2015 – Central Statistics Office (www.cso.ie/en/releasesandpublications/er/iss/informationsocietystatistics-enterprises2015)*
[23] *Business opportunities: Social media, July 2013 – European Commission (www.ec.europa.eu/growth/tools-databases/dem/sites/default/files/page-files/social_media_v1.1.pdf)*

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4.2 Mobile applications

The rapid growth of the number of mobile devices is a trend that cannot be ignored by the ICT-sector. Mobile applications are present everywhere and are big business. EU developers took in € 17.5 billion in revenue in 2013, and forecasts are this will increase to € 63 billion in five years. The amount of people employed in the mobile application development industry will grow from 1 million in 2013 to 2.8 million in 2018 in the EU alone. [24] These numbers are backed up by user statistics.

According to data from Global Web Index:[25]
- 41% of people look at their mobile phone as their number one device
- 33% of minutes spent online each day are now on mobile
- 62% use the Facebook app every month

When we look at the data from Google/Ipsos Connect UK we see most people are loyal to one travel and finance app. But in retail people often have various apps installed on their device, 11% even has over 20 retails apps installed.[26]

According to these statistics there is plenty of room and opening for new applications to gain ground. They can respond to new needs and incorporate new technological developments.

There are still numerous opportunities in developing apps, since many companies, organizations and governments aren't present with an application. Especially in the development and deployment of financial applications, focused on e-payments ground can be gained. Ireland adopted the usage of electronic payments in the last four years, and innovations to ban all cash are on their way, boosting the Irish economy.[27]

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[24] *Sizing the EU App Economy - Eurapp*
(www.eurapp.eu/sites/default/files/Sizing%20the%20EU%20App%20Economy.pdf)
[25] *Global Web Index blog (www.globalwebindex.net/blog/mobiles-seen-as-most-important-device)*
[26] *Mobile Apps and Sites – Google and Ipsos Connect UK, July 2015*
(https://storage.googleapis.com/think-v2-emea/v2/18f32_Mobile%20Apps%20and%20Sites%20-%20Google-Ipsos%20research%20-%202015%20-%20New%20Version.pdf)
[27] *Move to electronic payments adds € 1.8bn to Ireland`s coffers*
(www.siliconrepublic.com/companies/electronic-payments-ireland-economy-visa-moodys)

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4.3   Cloud computing

With the rise of internet speed and accessibility, more and more internet applications are being introduced. One of them is cloud computing, where data are stored on external/internal storage spaces, which can be accessed through the internet. This is very interesting for business, since they don't have to invest in hardware for storage of their data. Also many people use it without knowing they are, for instance Gmail and Dropbox are free available cloud services. There are three different models commonly used in cloud computing services. Infrastructures-as-a-service (IaaS), Platform-as-a-service (PaaS), and Software-as-a-service (SaaS). This is often referred to as the Cloud Computing Stack[28]. SaaS/PaaS sales already make up 10% of revenues of Top 50 software companies, according to a study published by PWC.[29] There are also three different types of clouds; the public, private and hybrid cloud. [30]

Irish enterprises are adopting cloud computing services at a rapid speed. Figures from the Central Statistics Office show that almost 35% of enterprises in Ireland have bought such a service in 2015.[31]
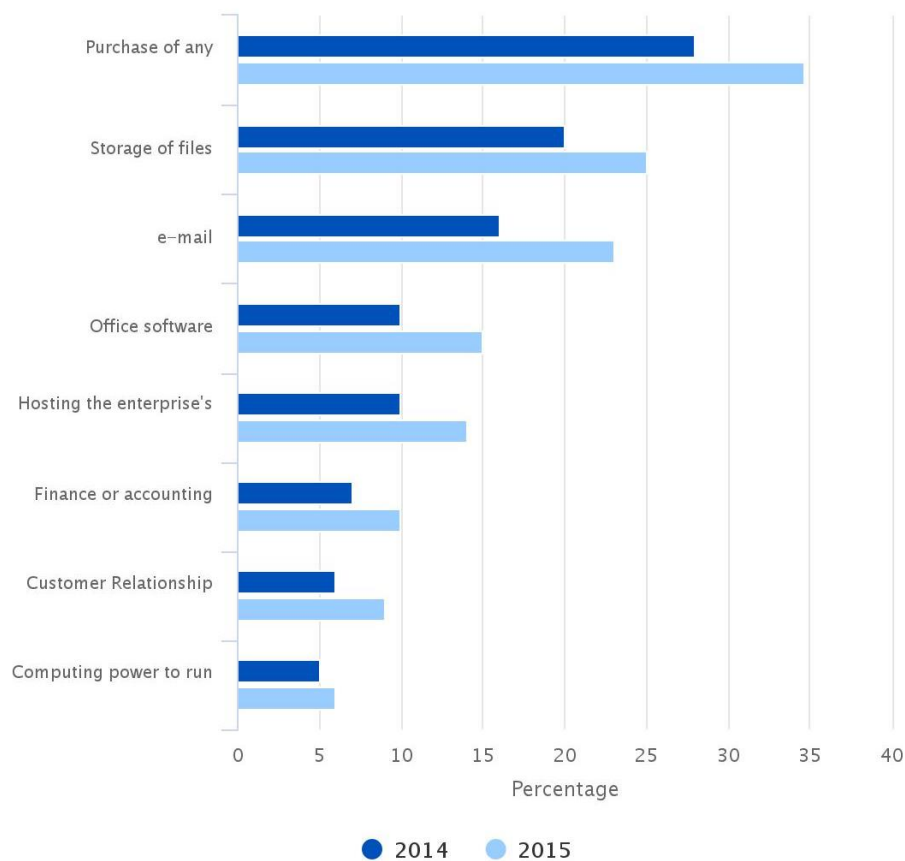
Source: CSO Ireland

Source: Cloud Computing Services - Information Society Statistics, Enterprises 2015 – Central Statistics Office

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[28] *Understanding the Cloud Computing Stack: SaaS, PaaS, IaaS - Rackspace (https://support.rackspace.com/white-paper/understanding-the-cloud-computing-stack-saas-paas-iaas)*
[29] *25 Fastest Growing Cloud Companies – PWC Technology Institute (www.pwc.com/gx/en/technology/publications/global-software-100-leaders/assets/25-fastest-growing-cloud-companies.pdf)*
[30] *What is cloud computing? - IBM Cloud (www.ibm.com/cloud-computing/what-is-cloud-computing)*
[31] *Cloud Computing Services - Information Society Statistics, Enterprises 2015 – Central Statistics Office (www.cso.ie/en/releasesandpublications/er/iss/informationsocietystatistics-enterprises2015)*

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Many companies in the cloud computing sector have their European datacentres in Ireland, e.g. HP, Google, IBM, Amazon, Microsoft, etc. Ireland is an interesting place for cloud computing, because of different reasons, such as tax, skilled workforce, location, etc. But, there is a specific benefit in Ireland for cloud computing, compared to many other countries. Since the Irish weather is constantly moderate, data centres only need 19 cooling days, compared to 40 in Iceland and 43 in Norway.

Two of the major drivers of the cloud development in Ireland are the Irish Centre for Cloud Computing and Commerce (IC4), and the Irish Data & Cloud Cluster (IDCC).[32]

Some of the major facilities are[33]:

Operator	Estimated Installed Capacity(MW)	Location
BT	10	Dublin
Citadel100 / HP	20	Dublin
Confidential Client	140	Dublin
DRT	3	Dublin
Eircom	20	Dublin
CIX	1	Cork
Telecity (Equinix)	19.5	Dublin
Google	80	Dublin
IBM	22	Dublin
Interxion	8	Dublin
Microsoft	80	Dublin
EBay	Unknown	Dublin
Vodafone	Unknown	Dublin
DataPlex	10.5	Dublin
Yahoo	Unknown (leased data centre)	Dublin
Total	**414 MW**	

Source: Major € 3.7bn Data Centre Influx Projected for Ireland – Irish Wind Energy Association

On the educational side, Cork Institute of Technology and Dell EMC recently collaborated on the development of the world's first suite of undergraduate- and masters-level degree programs in cloud computing, namely Cloud Academy (http://cloud.cit.ie). On the website of the Irish Data & Cloud Cluster (www.theidcc.com/ecosystem.html) you can find the following directories: Universities, Accelerators, State Agencies, Venture Capitalist Funds, Start-Ups, and Service Providers. This governmental website is a good place to find a possible partner or opportunity in Ireland's big data or cloud computing sector.[34]

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[32] *Special Report: Ireland - 451 Research (www.slideshare.net/Irishtiger/451-advisors-ireland-special-report-1)*
[33] *Major € 3.7bn Data Centre Influx Projected for Ireland – Irish Wind Energy Association (www.iwea.com/viewnews&id=139)*
[34] *The Irish Data & Cloud Cluster - (www.theidcc.com)*

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4.4   Microelectronics

The microelectronics sector is present in Ireland since 1976 with the establishment of Analog Devices in Limerick. The next big company to arrive in Ireland was Intel, setting up in Leixlip in 1989. The sector grew thanks to innovation fuelled by indigenous enterprises, and several universities and Institutes of Technology. More and more research centres and global microelectronic companies found their way to Ireland. Nowadays the biggest driver of the industry is the Internet of Things (IoT), on which we will focus in the next chapter.[35] But what are microelectronics?

> "Microelectronics is that area of electronics technology associated with electronics systems built from extremely small electronic parts of elements. Most of today's computers, weapons systems, navigation systems, communications systems, and radar systems make extensive use of microelectronics technology."[36]

The most notable R&D-facilities in Ireland are:
- Tyndall National Institute
- CRANN Institute
- Microelectronic Circuits Centre Ireland (MCCI)

Some of the biggest semiconductor and microelectronics companies are present in Ireland:

Analog Devices	ARM	Cadence
Cypress Semiconductor	Intel Corporation	Microsemi Corp
On-Semiconductor	Parade Technologies	Qualcomm
ROHM	Synopsys	Xilinx

Ireland is also a vibrant place for start-up businesses in the semi-conductor sector. Irish based start-up companies Commergy, Firecomms, GloNav, ChipSensors, Mingoa, Duolog and Redmere have all been acquired in the last six years for over € 100M. In the last five years Ikon Semiconductor, Decawave, Powervation and Movidius have raised over € 30M.[37]

Given the rising popularity of mobile, IoT, drones and other robotics there is certainly a bright future for the microelectronics sector.

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[35] *Background - MIDAS Ireland (www.midasireland.ie/background.cfm)*

[36] *Microelectronics - Universidad Tecnica Federico Santa Maria
(www2.elo.utfsm.cl/~lsb/elo102/datos/microelectronics.pdf)*

[37] *5 Reasons why Semiconductor companies choose Ireland - IDA Ireland
(www.idaireland.com/newsroom/blog/2015/04/09/5-reasons-why-semiconduct)*

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4.5   Internet of Things (IoT)

The Internet of Things is changing the way we live, work and do business very rapidly. Thanks to the availability of internet and development of microelectronics, IoT is popping up everywhere around. "Smart" is the new keyword, but first let us give a definition of IoT:

> "We define the Internet of Things as sensors and actuators connected by networks to computing systems. These systems can monitor or manage the health and actions of connected objects and machines. Connected sensors can also monitor the natural world, people, and animals."[38]

So IoT is a form of artificial intelligence, since the system is able to learn by itself. The forecasts say 34 billion devices will be connected to the internet by 2020.

The IoT created numerous opportunities, but according to a report about IoT from EY the following are the primary forces to adopt and implement the IoT[39]:

- New business opportunities
- Potential for business revenue growth
- Improved decision-making
- Cost reductions
- Safety and security
- Improved citizen experience
- Improved infrastructure

Ireland is considered one of the leading countries in implementation of the IoT[40]:

- One of the first countries to establish a Ministry of Data Protection
- Smart Dublin is a testbed for IoT, wherein government, universities and industry join forces. Some of the most remarkable projects are the deployment of IoT in Croke Park, the placement of Smart Bins across Dublin and the implementation of a smart energy monitoring system in the Docklands area.[41]
- High-end R&D in Ireland by private companies; e.g. Intel, Dell, IBM, EMD, Vodafone, …
- Fastest broadband speed in Europa (2nd globally)

Although IoT has just begun to see daylight and R&D is ongoing, many applications are already present in our everyday lives: wearables, replenishment, wireless sensing and tracking, health and well-being, home automation, environment, agriculture, hospitality and tourism, and industry. [42]

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[38] *The Internet of Things - McKinsey Global Institute (www.mckinsey.com/industries/high-tech/how-we-help-clients/internet-of-things)*
[39] *Cybersecurity and the Internet Of Things, March 2015 – EY (www.ey.com/Publication/vwLUAssets/EY-cybersecurity-and-the-internet-of-things/$FILE/EY-cybersecurity-and-the-internet-of-things.pdf)*
[40] *Internet of Things & Ireland - IDA Ireland (www.idaireland.com/how-we-help/resources/infographics/internet-of-things-(iot))*
[41] *Smart Stories - Smart Dublin 2016 (www.smartdublin.ie/smart-stories)*
[42] *9 Examples of How the Internet of Things Is Already Disrupting Just About Everything - Entrepreneur (www.entrepreneur.com/article/281757?utm_content=buffer4eff3&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer)*

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4.6   E-commerce

E-commerce is often referred to as the digital economy. This covers: products and services which are bought online, business and employees delivering them, and business and government spent conducted over the internet. An interesting fact is that the digital economy seems to be (more) resilient to economic volatility than other parts of the economy. The Irish digital economy is currently worth about 6% of Ireland's GDP. The average amount online spent in Ireland per adult has risen from € 71 in 2014 to € 80 in 2016. But a lot of the money spent online is moving out of Ireland. On a global scale 57% of people have bought something online from a business in a foreign country. In Ireland the level of people buying on international sites even reached 68% in 2014/2015. The forecasts are that Irish consumers will spend up to € 14.1 billion a year by 2020 on e-commerce sites, an increase of 53%. These insights and the following ones were formed by data taken from the *Consumer Barometer* of Google and the *Digital Insights Report 2016* of Virgin Media.[43][44]

Products bought online abroad in Ireland:

- 53% of clothing, accessories and footwear
- 50% of books, CDs, DVDs or video games
- 25% of computer hardware, software of peripheral
- 24% of cosmetics, beauty or health products

Not only individuals, but also Irish enterprises are part of the digital economy. In 2015, 53% of Irish large enterprises had e-commerce sales, 51% of medium-sized enterprises, and 28% of small enterprises and an even bigger part of Irish enterprises made e-commerce purchases in 2015.[45]

According to the report from Virgin Media the share of Irish websites in online sales has remained the same over the past years. There are definitely opportunities for retailers to create substitution products responding closely to the specific needs of Irish customers. Especially with the expected growth in online spending by Irish customers and the limited domestic market.

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[43] *The International Shopper (IE) - Google Consumer Barometer*
(www.consumerbarometer.com/en/insights/?countryCode=IE)
[44] *Digital Insights Report 2016 – Virgin Media (www.virginmedia.ie/pdf/VM_IE_Digital_Insights_Report.pdf)*
[45] *E-commerce - Information Society Statistics, Enterprises 2015 – Central Statistics Office*
(www.cso.ie/en/releasesandpublications/er/iss/informationsocietystatistics-enterprises2015)

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4.7   Games

The gaming sector is changing rapidly, and the traditional seven-year lifecycle of gaming consoles is broken down. While it more or less stayed the same for 30 years, the past 10 years' change has struck with the rise of the internet. Games are more and more distributed digitally, with services like Steam playing a leading role in this evolution. Traditional games had to reinvent themselves, and now are offering extra packages that can be bought to upgrade the game and keep gamers engaged.

Traditional gaming studios are also disappearing and clearing space for digital offices with a workforce spread around the world, or for development hubs shared between different studios.[46]

> "This is the games industry in 2016. Not the highly stratified, hierarchical model of a decade ago, but a largely digital, incredibly fluid creative community, in which talented developers switch seamlessly between roles, studios and projects. But the uncertainty and complexity has brought with it a new approach to development, with micro-publishers, shared spaces, regional funds and improvised collaborations. This is an industry in which the big publisher-owned studios still exist of course, but where some of the most intriguing and disruptive work is coming from remote groups of teams."[47]

Next to these changes in the gaming sector there is a strong growth in mobile gaming. In Europe 50% of mobile phone users use their device to play games. This is just a small percentage compared to the global average of 64%. European gamers appear to prefer playing games on their PC and laptop. Also only 15% of mobile gamers have actually paid for a game in the last month.[48]
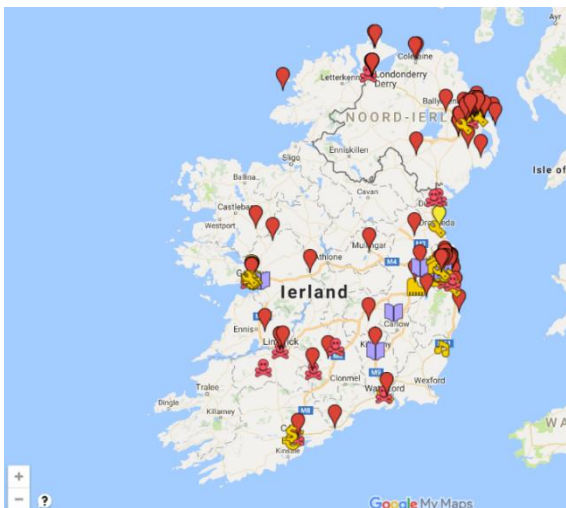
Ireland is a hub for gaming operators; from traditional game developers such as Microsoft to the small developers and online casino companies. According to estimates the online casino gaming industry could be worth € 7.5 billion in Ireland, and create 10 000 new jobs by 2020. Adding the € 3 billion the video game industry is worth, it is clear the gaming sector is of serious importance for the Irish economy.[49] Gamedevelopers.ie published a map of the Irish games sector, which gives a clear view on the spread across the Republic of Ireland and Northern Ireland.[50]

Source: A Map of the Irish Games Industry – gamedevelopers.ie

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[46] *The digital apocalypse: how the games industry is rising again - The Guardian*
(www.theguardian.com/technology/2016/may/17/video-game-industry-changing-virtual-studios)
[47] *The digital apocalypse: how the games industry is rising again - The Guardian*
(www.theguardian.com/technology/2016/may/17/video-game-industry-changing-virtual-studios)
[48] *Global Web Index blog (www.globalwebindex.net/blog/only-15-paying-for-mobile-games) +*
(www.globalwebindex.net/blog/6-in-10-gaming-on-their-smartphones)
[49] *How the gaming industry is helping the Irish recovery - Business World*
(www.businessworld.ie/news/How-the-Gaming-Industry-is-Helping-the-Irish-Recovery-562876.html)
[50] *A map of the Irish Games Industry – gamedevelopers.ie (www.gamedevelopers.ie/irish-games-industry-map)*

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4.8 Augmented, Virtual & Mixed Reality

Augmented, virtual and mixed reality are all quite new technologies in the ICT-world. They have been around for a couple of years, but new innovations and applications are developed faster than ever before.

The forecasts display the huge potential growth of equipment sales from about € 1 billion in 2016 to over € 20 billion by 2020 on a global scale.[51] Worldwide in VR the biggest players and their flagship devices, at the moment, are Sony PSVR, Oculus VR and HTC Vice. Another player in the market is Google's Cardboard, which enables your mobile device to become the VR screen. [52]

The possible applications are numerous. VR being predicted a future rather in the gaming and porn industry, for personal entertainment use at home. And AR being predicted a bright future in everyday personal and business usage. MR is expected to be used widely in training, e.g. of surgeons to practice performing surgeries on virtual patients, but using their hands in real-life.

That Ireland is taking advantage of the VR opportunities is shown by an example of Fáilte Ireland, who launched a VR tour of the Wild Atlantic Way on the Irish west coast.[53] Many opportunities lie in the implementation of VR and AR technologies in Ireland. Especially since Irish people are known to be early adopters of new technologies. A number of Irish companies are targeting VR and AR. Some recent examples[54]:

- Irish property firm Sherry FitzGerald plans to hold virtual house viewings (www.sherryfitz.ie)
- Gaming for Peace project; a € 2 million game to train police and soldiers developed at TCD.
- THRIVE creates immersive 3D audio for virtual reality (www.mee.tcd.ie/thrive)
- MindMyths wants to provide mindfulness training in VR (www.mindmyths.eu).
- iTagged creates holograms from pictures, memes, videos, … (www.itagged.com)

Ireland presents itself as an ideal testbed and R&D-centre for AR, VR and MR technologies.

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[51] *The Real Promise for Virtual Reality – BloombergGadfly (www.bloomberg.com/gadfly/articles/2016-08-04/real-promise-for-virtual-reality-are-suits-not-gamers)*
[52] *Virtual Reality. The new medium for everything? - Irish Tech News (www.irishtechnews.net/ITN3/virtual-reality-the-new-medium-for-everything-by-damian-cranney)*
[53] *Fáilte Ireland launches Virtual Reality tours of the Wild Atlantic Way - The Irish Independent (www.independent.ie/life/travel/travel-news/filte-ireland-launches-virtual-reality-tours-of-the-wild-atlantic-way-34547939.html)*
[54] *With VR close to launching, what is Ireland bringing to the table? – TheJournal.ie (www.thejournal.ie/vr-development-ireland-2641856-Mar2016)*

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5 Research & Development

Knowledge Transfer Ireland (KTI) works with business, investors, universities, Institutes of Technology, State research organisations, research funders and government agencies to maximize State funded technology, ideas and expertise getting into the hands of business to drive innovation. KTI is located in Enterprise Ireland (EI) and funded by EI with co-financing from the Irish Universities Association (IUA). On the website of Knowledge Transfer Ireland, you can find a map that lists all the official research centres in Ireland. There are different categories.

You can find the link to the map here:
http://www.knowledgetransferireland.com/Find-a-Research-Partner/Research-Map-of-Ireland

6 Associations, organisations & websites

www.cita.ie - Construction IT Alliance
Network of stakeholders in the Irish Construction Industry that efforts to grasp the benefits of IT.

www.thedigitalhub.com - Digital Hub Development Agency
Irish state agency that runs The Digital Hub, a cluster of digital content and technology enterprises, located in the centre of Dublin.

www.gamedevelopers.ie - Gamedevelopers.ie
Volunteer run project that exists to help local game developers both inside and outside of the industry to network, communicate and publicise their work.

www.gamesireland.ie - Games Ireland
Not-for-profit organisation working to support, promote and drive sustainable growth for the games industry in Ireland.

www.ics.ie - Irish Computer Society
Society which mission is to advance, promote and represent the interests of ICT professionals.

www.ictireland.ie - ICT Ireland
Representative body for the technology sector and part of Ibec. ICT Ireland represents its members to the government, regulators and customers.

www.theidcc.com – Irish Data & Cloud Cluster
The Irish Data and Cloud Cluster was created to facilitate and accelerate the growth of cloud computing and data analytics sectors in Ireland.

www.software.ie – Irish Software Association
Association within Ibec, which represents the Digital and Software Technology Sector.

www.isin.ie - Irish Software Innovation Network
Network managed by the Irish Software Association. It provides matchmaking and knowledge-brokering services to help software companies identify and engage with relevant third-level research institutes.

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www.irishtechnews.net – Irish Tech News
Online publication on Irish technology news.

www.itag.ie – Information Technology Association Galway
Association of professionals and companies from the IT-sector. Promotes Galway as an excellent location for IT-development.

www.itcork.ie – IT@Cork, European Tech Cluster
Not-for-profit business organisation, representing the interest of the IT industry in Ireland.

www.knowledgetransferireland.com – Knowledge Transfer Ireland
KTI works with business, investors, universities, Institutes of Technology, State research organisations, research funders and government agencies to maximise State funded technology, ideas and expertise getting into the hands of business to drive innovation. Funded by EI and IUA.

www.midasireland.ie – MIDAS Ireland
Organisation that helps define and develop the future direction of the micro and nano-electronics based 'system solutions' industry in Ireland. Includes IDA, EI and universities and Institutes of Technology involved in the sector.

www.pdsttechnologyineducation.ie – PDST Technology in Education
Part of the national support service, and promotes and supports the integration of ICT in teaching and learning in first and second level schools.

www.siliconrepublic.com – Siliconrepublic
Irish news website for technology news.

www.sfi.ie – Science Foundation Ireland
Foundation that funds and supports oriented basic and applied research in the areas of STEM.

www.techcentral.ie – TechCentral
Website of the Irish technology magazine TechPro.

www.tif.ie – Telecommunications and Internet Federation
Representative body for industry and interest groups in the field of electronic communications. Part of Ibec and associated with ICT Ireland.

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7   Events

ARVR Innovate Conference - www.innovatereality.com
Conference about Augmented and Virtual Reality.
11 May 2017 (Croke Park Conference Centre, Dublin)

Datacentres Ireland - www.datacentres-ireland.com
Exhibition and conference about every aspect of planning, designing and operating your datacentre, server room, storage facility or solution.
8-9 November 2016 (RDS, Ballsbridge, Dublin 4)

Dublin Comic Con - www.dublincomiccon.com
Exhibition and gathering on gaming, comic books, …
12-13 August 2017 - (CDD, Dublin 1)

Dublin International Game Music Festival - www.idigmusicfest.com
Exhibition and lectures all about game music.
RDS, Ballsbridge, Dublin 4 + CCD, Spencer Dock, North Wall Quay, Dublin 1)

Dublin Tech Summit - www.dublintechsummit.com
Summit about the global technology present in Dublin
15-16 February 2017 (Dublin's Silicon Docks)

eCommerce eXpo Ireland - www.ecommerceexpoireland.com
Expo designed to educate Irish business about e-commerce and selling online.
22 March 2017 (Crowne Plaza Dublin Northwood)

Games Fleadh - www.gamesfleadh.ie
Digital Games Programming Festival; for students, companies, …
8 March 2017 (LIT Thurles Campus, Co. Tipperary)

Internet of Things World - https://tmt.knect365.com/iot-world-europe
Convention with an exposition and speakers on IoT.
20-22 November 2016 (CCD, Dublin 1)

Medtec Ireland - www.medteceurope.com
Event hosted by UBM EMEA for medical device manufacturers.
4-5 October 2016 (Radisson Blu Hotel, Galway)

Retail Ireland Summit 2 - www.retailsummit.ie
Conference about retail organized by Ibec. In 2016 focus on omni-channel retail.
6 October 2016 (Guinness Storehouse)

Research & Innovation Conference & Exhibition - www.innovateireland.ie
Exhibition and conference on research and innovation with industry leaders and government bodies, research bodies. Organized in the structure of Ireland Global Innovation Hub 2020.
14 February 2017 (Croke Park)

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Tech Connect Live – www.techconnect-live.com

Hosted by the city of Dublin, gathering of technology companies, start-ups, investors and the largest Irish and global end users of technology and services.

25 May 2017 (RDS, Ballsbridge, Dublin 4)

UXDX Conference – www.uxdxconf.com

Conference on UX (user experience) and DX (developer experience) with speakers, companies, ...

2 November 2016 (RDS, Ballsbridge, Dublin 4)

UX Ireland – www.uxireland.net

Conference on UX, UI and User Research with speakers, companies, ...

10-11 November 2016 (Trinity Biomedical Sciences Institute, Dublin)

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