# Forecasting the Future Demand for High-Level ICT Skills in Ireland, 2017-2022

March 2019

**National Skills Council**

Expert Group on
**Future Skills Needs**
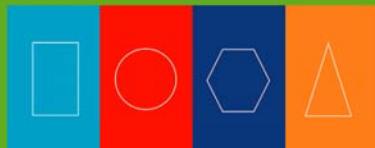
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# Acknowledgements

# Introduction to the Expert Group on Future Skills Needs

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

Specifically, the EGFSN:

- Carries out research, analysis and horizon scanning in relation to emerging skills requirements at thematic and sectoral levels. Steering Groups comprising of experts from relevant enterprise sectors and the education and training sector may oversee sectoral research studies to be undertaken or commissioned by the EGFSN. Drawing on statistical input and analysis from the Skills and Labour Market Research Unit and consultation with the enterprise/education experts as part of the study, draft reports setting out the projected needs are prepared by the EGFSN.

- Engages with the Higher Education Authority, SOLAS, Quality and Qualifications Ireland, the Regional Education Fora, and education and training providers in the course of its research.

- Engages with Department of Education and Skills, Higher Education Authority, SOLAS and other relevant bodies to produce agreed action plans to address the skills needs identified.

- Submits the findings of its research and agreed Action Plans to the National Skills Council prior to publication.

- Disseminates its findings to the Regional Skills Fora and other relevant groups.

The Strategic Policy Divison within the Department of Business, Enterprise and Innovation provides the EGFSN with research and analysis support.

# Foreword

This Expert Group on Future Skills Needs study forecasts the demand for high level ICT skillsets in Ireland across all sectors of the economy over the period 2017-2022. This study marks a continuation of the EGFSN's key supporting role to the ICT Skills Action Plan process- a structured approach to ensuring the ICT skills needs of the Irish economy are met, and that the growth of the ICT sector, the broader Irish economy, and Ireland's status as a global leader in ICT talent and skills is maintained.

This study was previously undertaken by the EGFSN in 2013, and informed the supply response of the 2014-2018 ICT Skills Action Plan, which has been successful in increasing the output of high level ICT graduates, as well as the flow of international ICT talent to Ireland. As this refresh study shows, however, the Irish economy has now moved on to a higher growth plane in terms of the demand for high level ICT skillsets. And this will be sustained in the period to 2022.

Driven by the continued growth of Ireland as a global technology hub, as well as the spread of digitalisation across all sectors of the economy, demand is forecast to grow at 8.5% annually, generating potential job openings of almost 73,000 during the period 2018-2022. This is far in excess of the growth anticipated under the 2014-2018 ICT Skills Action Plan. The findings of this study, both quantitative and qualitative, have informed the development of the new Action Plan, which will cover the years to 2022. I urge all relevant stakeholders- Government, Industry, and the education and training sector- to maximise their response to the demand forecasts set out in this report, in order to achieve the necessary step change in Ireland's ICT skills supply performance.

I would like to thank all those who contributed to the development of this report. Particular thanks are due to the more than 100 enterprises and stakeholders who contributed their time and expertise through their participation in workshops and survey consultations with the project consultants and EGFSN Secretariat. In particular, I would like to thank Paul Sweetman who chaired the steering group that oversaw the completion of the report, and each member of the Steering Group for their commitment and for sharing their expertise. Finally, I would like to thank the EGFSN Secretariat for managing and leading this project to a successful conclusion.

Tony Donohoe

Chairperson, Expert Group on Future Skills Needs
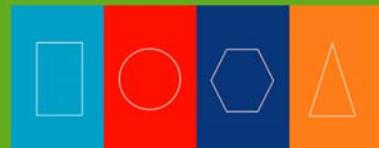
# Executive Summary

The availability of appropriate skills for developing, implementing and using information and communication technology (ICT) is an important condition for the competitiveness and the innovation capabilities of the European and national economies. The skills required go far beyond the narrow confines of traditional ICT practitioner expertise. In the digital economy, ICT practitioners are expected to have additional skillsets, such as business, analytical and foreign language skills.

In the past two decades, Ireland has been successful in developing these skills internally as well as enticing qualified talent from overseas and thus developing its high-end technology sector and attracting many multinationals. However, the current trend for digital transformation is steadily driving the need for ICT skills to new levels. According to studies on monitoring skills demand and supply, by 2020 there will be a demand for almost 6.3 million IT professionals in the EU. And supply is not keeping up. The resultant strong competition for skills, especially in a region where there is free movement of labour, makes it of significant importance to develop, attract and retain the right high-level ICT skills to satisfy the demand across the Irish economy. Likewise, it is imperative for Ireland to be able to continue to attract and serve the R&D activities, high-tech manufacturing and global services companies that are important for Ireland's economic growth.

The development of the ICT Skills Action Plan 2014–2018 was informed by the detailed work of the Expert Group of Future Skills Needs (EGFSN) High-Level ICT Skills study. The plan contained 22 actions, which drew on recommendations contained in the EGFSN study, aimed at boosting both the quantity and quality of supply of high-level ICT skills to meet the demand projected by the Central Growth Scenario. Under this scenario, the demand for ICT practitioners was forecast to grow at a compound annual growth rate (CAGR) of nearly 5% over the forecast period 2013-2018. In a higher growth scenario, demand for ICT practitioners was forecast to grow at a CAGR of over 7.2% over the period.

In 2013, the higher growth scenario was considered more likely to occur in the medium to long term provided the economy recovered and companies made the necessary investments in technologies — and hence needed also to employ more skilled ICT practitioners. Indicators suggest that, from 2016 onwards, this has indeed been the case in Ireland. Some of these indicators include:

- Employment survey results indicating that IDA Ireland ICT-related client firms' full-time employment grew by 8.4% in 2016, while employment in Enterprise Ireland ICT-related client firms grew by 9%.
- Demand for ICT practitioners in part being met through the attraction of foreign talent. In 2016, 3,180 ICT employment permits were issued — a 27% increase from 2015. In 2017, the number was 3,442 — an increase of 8.2% over 2016.

Against this backdrop, Ireland once again needs to assess the likely future demand for ICT skills so that it can take the appropriate actions to address the needs of its indigenous ICT industry, the

large number of MNCs, as well as the requirements for specific skills in the IT departments in the various industry sectors.

The EGFSN engaged IDC to forecast the demand for high-level ICT skills over the period 2017–2022 arising from the broad ICT sector as well as across other sectors of the economy. The specific skills examined at NFQ Levels 6/7 and NFQ Levels 8+ are:

a) Computing skills (including computing software engineering and computer programming as well as multimedia gaming with a substantial computing component) and

b) Electronic and electrical engineering skills (including communications and mechatronics, and electronic/computing engineering)

## Research Approach

The approach to arriving at the demand forecast and the associated key study findings has several strands:

- Use of IDC's in-depth knowledge and existing body of research in ICT markets, including global and regional demand trends and forecasts on ICT spending and end-user surveys, developed and published by IDC's expert analysts

- Interviews with 20 key informants/stakeholders in Ireland from trade associations, government bodies, academia and professional bodies

- Interviews with 40 enterprises in their role as employers of those with ICT skills

- Workshops held in Dublin and Cork attended by a broad range of stakeholders as above

- Input and guidance from an EGFSN steering group with representatives from the full range of stakeholders above

This research process is combined with IDC's proprietary ICT skills demand model to create the demand forecast presented in this study. This model has been used for more than a decade on behalf of the European Commission, to forecast the demand for ICT practitioner skills in Europe.

For this study, the demand model is adapted to reflect the specific Irish conditions. As a small open economy with a strong export focus, a large proportion of the skills needed are not just reliant on demand created in the domestic market. Demand is also strongly dependent on market conditions and demand patterns in the global ICT market, as well as the competition for FDI and availability of skills from other countries and regions around the world.

Three different scenarios are then developed, with a central scenario that is most likely to occur. This process is outlined in Figure 1.
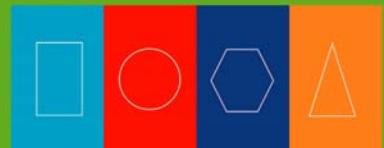
**Figure 1: Schematic View of Scenario Building and ICT Skills Demand Forecast**
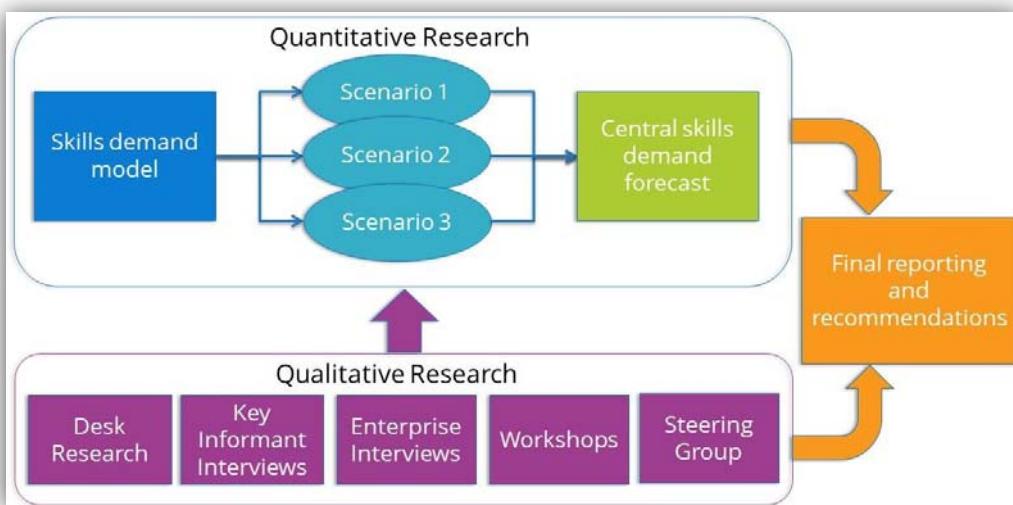


Source: IDC, 2018

## Global Technology and Service Trends Influencing Irish Skills Demand

The worldwide ICT market is forecast to grow by a CAGR of only 3% in the period 2016–2021, according to IDC's forecast. However, below these topline numbers are strong growth markets for emerging technologies, which are driving fundamental change to businesses and consumers around the world.

These new technologies are termed "Innovation Accelerators", as shown in Figure 2. These are very diverse technologies such as cognitive systems and artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, augmented and virtual reality, and next-generation security. However, a commonality between them is that they are enabled by what is described as the 3rd Platform of cloud, Big Data/analytics, mobility and social media. The previous platforms were client/server (2nd Platform) and mainframe (1st Platform).

**Figure 2: Emerging Technology Trends**
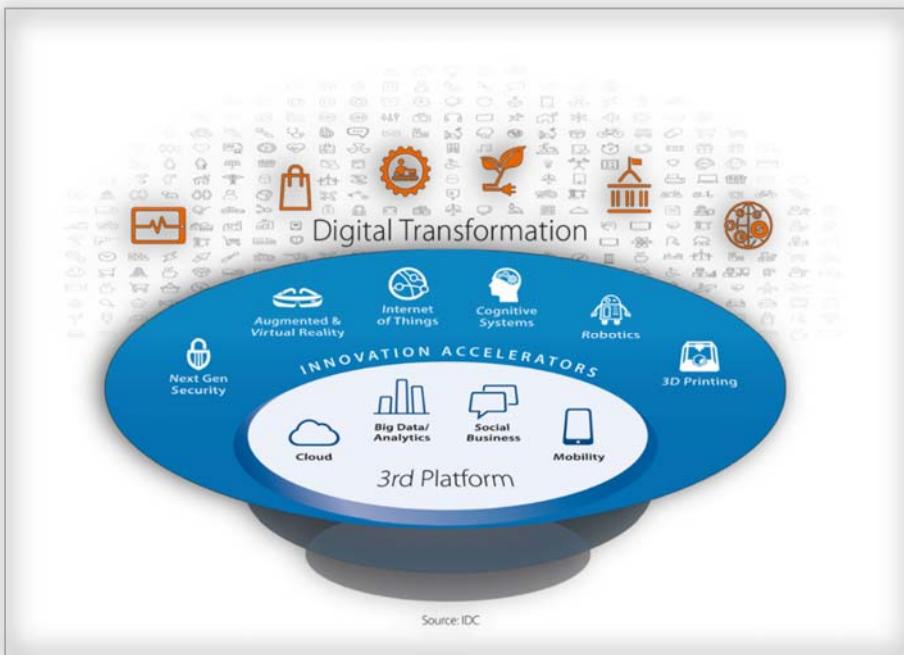


Source: IDC

Source: IDC, 2018

The possibilities of how to deploy these new technologies to change business models, innovate products and services, and radically improve customer experiences are only just emerging. But this does not mean that organisations around the world are not thinking about what they can do for their businesses. Research shows that 84% of the CEOs of the FT500 companies already have digital transformation at the centre of their corporate strategy.

Digital transformation has been a strong theme in both business and IT over the past five years or so — and often a misused term used for almost any kind of new technology adoption. However, implementation of new digital technology does not necessarily mean it is digital transformation. There are two characteristics for real digital transformation. One is that the technology adoption must be about transforming the business and not about the technology itself — so digital business transformation would be a much better term. The other guiding principle is that true digital business transformation is an ongoing process that requires cultural change. Because of the speed of technology change, treating digital transformation as a one-off project would mean that in a brief time the organisation would once again be behind competitors and peers in the market. Enter the era of continuous innovation.

It could be argued that a spate of new ICT coming to market is nothing new — but what is new is how organisations are looking to apply these technologies. They are no longer in the realm of the IT department only and neither are the skills needed for technology adoption. This places even more
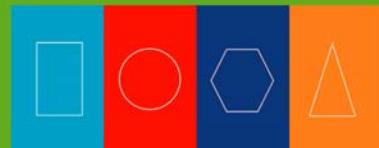
emphasis on "hybrid" skills — people that understand how to straddle between business and technology.

## The View from Stakeholders

The research with ICT industry stakeholders identified a number of areas that need to be addressed if the sector is to continue the successful path of recent years.

- Despite major improvements in the supply of graduates with ICT skills through the third- level education system in recent years, the numbers are still not sufficient. Further improvements are needed to promote ICT as a career and to encourage schoolchildren to take STEM subjects and choose STEM courses at third-level. That female representation in the ICT sector is much lower than male is a global phenomenon. However, it is strongly felt that continued efforts are needed to increase the proportion of females who take up careers in ICT. Other suggestions included a continuation of, and increase in, the retraining of people from other backgrounds and the unemployed in ICT skills. This also includes the importance of employers themselves having retraining and reskilling programmes for existing staff and new joiners.

- The new apprenticeship programme recently implemented by the government was seen by many as providing a very welcome new route into the ICT sector. The importance of students doing internships was also identified.

- Concern was expressed about the potential negative impact that Ireland's housing and infrastructure problems could have on the ability to continue to attract foreign nationals to come and work in Ireland. The country is "on the map" for people with ICT skills and is considered a good place to locate, if only temporarily. The negative PR arising from stories about rent increases and homelessness in Ireland could put this at risk.

- In light of the global scarcity of ICT skills, Ireland will continue to depend heavily on immigrant workers and it was suggested that changes be made to personal taxation rates, which it is claimed are acting as a disincentive to people wishing to locate in Ireland.

- Two subsectors of the ICT industry were suggested as being worthy of further attention and support by government and its agencies. Animation and gaming are both multibillion- euro industries at a global level. There are very significant enterprises in Ireland in each of these sectors with similar challenges, mainly related to sourcing specific ICT skills. Both industries are heavily dependent on a small number of third-level institutions as sources of skills. There would appear to be very considerable potential for enhanced growth for Irish enterprises in both sectors if they were able to source skills more readily.

The feedback and input from the workshops held in Cork and Dublin in January 2018 confirmed the findings from the interview phase. It also confirmed the status of the baseline scenario, "Keep Running to Win", as the most likely and realistic in the stakeholders' opinion. In addition, the participants recommended several actions to be taken by policy, industry and the education sector in collaboration or separately, but mostly underlined a feeling of urgency and the need to identify and implement measures with short-term impacts.
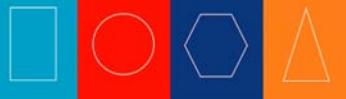
## ICT Skills Demand Scenarios, 2017-2022

In this study, scenarios were developed in parallel with the forecast model of ICT skills demand to help shape the growth trends and explain the rationale behind demand projections. Scenarios and the quantitative model are developed together so that feedback loops guarantee coherence and increase the solidity and reliability of forecasts. The main factors shaping the development of the scenarios are illustrated in Figure 3.

**Figure 3: Factors Shaping the Evolution of ICT Skills Demand**
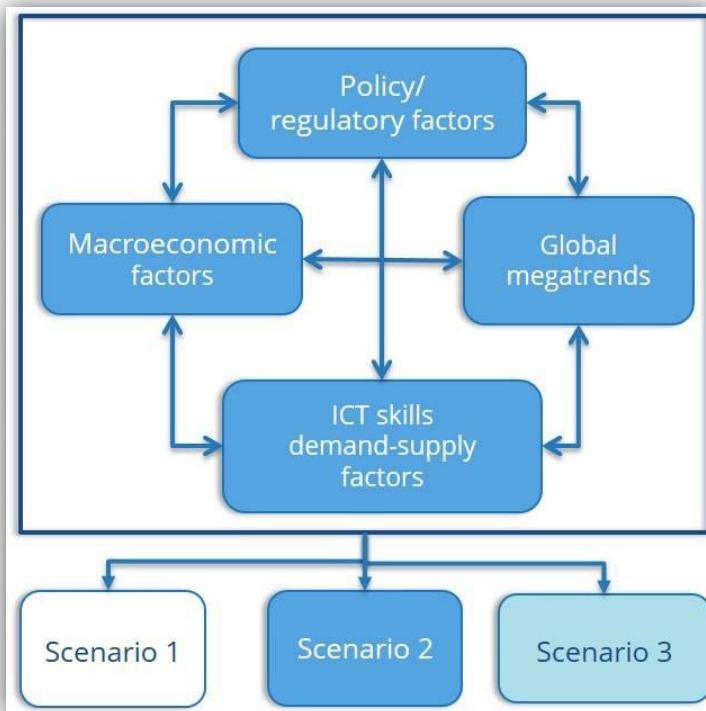


Source: IDC, 2018

The three scenarios designed for this study are as follows:

- Keep Running to Win (baseline or most likely scenario), where the continuation of healthy ICT market and macroeconomic growth trends as well as neutral Brexit impacts drive a dynamic increase in demand resulting in approximately 139,000 ICT skills demanded in 2022.

- Dancing with the Stars (high growth scenario), where the Irish ICT market moves into even faster growth, thanks to faster than expected adoption of ICT innovation and strong worldwide demand trends; the ICT industry improves its competitiveness (more start-ups, Irish multinationals moving higher up the value chain); and Ireland captures new opportunities opened by innovation, for example by becoming a leading hub for cloud-based data platforms in Europe. This pushes the ICT skills demand 5% higher than in the previous scenario, but with higher risks of a demand-supply gap.
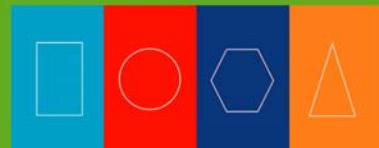
- Shaken by Cold Winds (low growth scenario), where negative external geopolitical shocks, negative "hard" Brexit impacts or changes in fiscal conditions or world market conditions result in ICT multinationals reducing their investments in Ireland, resulting in weaker than expected ICT adoption and ICT market growth. This results in an ICT skills demand in 2022 that is 27% lower than in the baseline scenario.

## Key Findings to Inform the ICT Skills Action Plan

The analysis carried out in the study highlights how the skills needs of the ICT market are rapidly evolving, both in quality and quantity, posing new challenges not only to the education and training system, but to the whole socioeconomic system. For example, attracting more females to ICT careers does not mean simply recruiting more females in STEM courses, but also changing common views about ICT being only for the extremely technology minded, as well as providing working conditions that enable the reconciliation of work and family life.

Stakeholders are very aware of these new challenges and many of them mentioned the need for a kind of "reset" of traditional ICT education and training policies, accompanied by a "rebranding" of the ICT profession, highlighting its pervasiveness in all sectors and company functions. They are also conscious of the need for stronger collaboration between industry and academia to achieve these goals. Another important challenge is to continue to develop Ireland's strong points as an attractive location for talent, leveraging the preference of ICT professionals for high-quality urban environments and trying to build up the attractiveness of other Irish cities beyond Dublin.

Stakeholders underlined the need for urgent action to deal with the increasing mismatch between skillsets available and demand for new emerging skills (in fields such as data analytics, artificial intelligence and cybersecurity). There is also increasing demand for soft skills, such as teamwork and problem-solving capabilities, which should be more of a priority for the education system; reinforcing such skills is also a target of Ireland's National Skills Strategy[1]. Some of the initiatives the stakeholders suggested go beyond the scope of the ICT skills Action Plans, but they are all relevant to reduce the potential demand-supply gap. These included:

- Improving the flexibility and productivity of the education and training system by:

  - Supporting initiatives to increase the recruitment of students with the appropriate aptitudes for computer science/STEM in all the sectors of the education system and when transitioning between sectors (primary, post-primary, higher education)

  - Launching new, shorter courses with non-traditional educators to respond to new skills demand and to help increase graduate output

  - Increasing investments to open more teaching positions in the STEM area

  - Introducing incentives for STEM teachers, since they have many other career opportunities

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1 See https://www.education.ie/en/Publications/Policy-Reports/pub_national_skills_strategy_2025.pdf
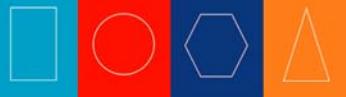
- Accelerating the introduction of coding in primary school and of digital skills from the early years, to open the minds of students and parents to ICT

- Multiplying internships and apprenticeships through increased collaboration between industry and academia

- Changing the image and perception of ICT careers by:

  - Promoting awareness campaigns about the relevance and role of ICT in all sectors to increase the understanding that ICT is not only about deep technology skills but also about understanding how technology can be applied in specific functions or sectors, such as healthcare or agriculture

  - Promoting ICT careers in schools and universities, and providing new role models and career perspectives, especially for females

- Attracting more women to ICT careers by:

  - Addressing awareness-raising initiatives about ICT jobs particularly to female students

  - Identifying and promoting female role models in the ICT profession

  - Paying special attention to gender issues in communications focusing on the ICT profession

- Improving Ireland's attractiveness for talent by:

  - Investing in the promotion of the "Ireland brand" towards foreign students

  - Expanding visa/work permit schemes, for example to include the animation industry

  - Increasing the provision of affordable housing

  - Improving public infrastructures and transportation services

Stakeholders also highlighted the need to sustain demand for ICT skills from Irish ICT users and supplier companies. On the demand side, the stakeholders prioritised the following main challenges and relative actions:

- Enabling Ireland to capture the opportunities of new technologies by:

  - Developing Ireland as a centre of expertise for specific technology areas, for example like Tubingen in Germany, which is emerging as an AI hub for data-driven innovation.

  - Supporting R&D efforts in collaboration between universities and industry, following the model of the leading US universities (such as MIT and Stanford).

  - Supporting entrepreneurship and start-ups by increasing available risk capital and promoting accelerators and incubators.

- Attracting talent to other regions beyond Dublin by:

  - Developing regional digital innovation hubs, favouring the interaction between local industry and research, particularly SMEs, thereby creating job opportunities for talent outside Dublin and reducing the pressure on housing and infrastructure in the capital. Urban renewal initiatives in
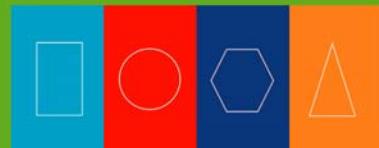
Cork, Galway, Limerick and Waterford can play an important role as ICT professionals are attracted by high-quality urban environments.

- This should be helped by the implementation of IDA Ireland's strategy "Winning: Foreign Direct Investment, 2015-2019"[2], which is targeting an increase of 30%-40% of investments to be attracted in all regions outside Dublin, and the National Planning Framework Ireland 2040[3], which plans for fast population growth mainly outside Dublin and the provision of public investments to address the public infrastructure deficit.

2 https://www.idaireland.com/docs/publications/ida_strategy_final
3 http://npf.ie/wp-content/uploads/Project-Ireland-2040-NPF.pdf
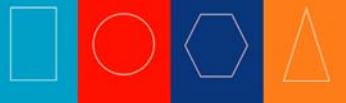
# Chapter 1- The Market for High-Level ICT Skills in Ireland

The availability of adequate skills for developing, implementing and using information and communication technology (ICT) is an important condition for the competitiveness and the innovation capabilities of the European and national economies. The skills that are required go far beyond the narrow confines of traditional ICT practitioner expertise. In the digital economy, ICT practitioners are expected to have additional skillsets, such as business, analytical and foreign language skills.

In the past two decades Ireland has been successful in developing these skills internally as well as attracting qualified talent from overseas, and thus developing its high-end technology sector and attracting many multinationals.

However, the current trend for digital transformation is steadily driving the demand for ICT skills to new levels. According to studies on monitoring skills demand and supply, by 2020 there will be a demand for almost 6.3 million IT professionals in the EU. And supply is not keeping up. The resultant strong competition for skills, especially in a region where there is free movement of labour, makes it of significant importance to develop, attract and retain the right high-level ICT skills to satisfy the demand across the Irish economy. Likewise, it is imperative for Ireland to be able to continue to attract and serve the R&D activities, high-tech manufacturing and global services companies that are important for Ireland's economic growth.

The development of the ICT Skills Action Plan 2014-2018 was informed by a forecasting and research exercise commissioned in 2013 by the Expert Group on Future Skills Needs and published later that year in its report "Addressing Future Demand for High Level ICT Skills".

This report presented two plausible demand scenarios for the 2013-2018 period for high-level ICT skills. These were:

- The central growth scenario, which was assessed as most likely to occur. Under this scenario, the demand for ICT practitioners was forecast to grow at a CAGR of nearly 5% over the forecast period.
- The higher growth scenario in which the demand for ICT practitioners was forecast to grow at a CAGR of over 7.2% over the period.

In 2013, the higher growth scenario was considered more likely to occur in the medium to long term provided the economy recovered and companies made the necessary investments in technologies — and hence also needed to employ more skilled ICT practitioners. Indicators suggest that, from 2016 onwards, this has indeed been the case in Ireland. Some of these indicators include:

- Employment survey results indicating that IDA Ireland ICT-related client firms' full-time employment grew by 8.4% in 2016, while employment in Enterprise Ireland ICT-related client firms grew by 9%.

- Demand for ICT practitioners in part being met through the attraction of foreign talent. In 2016, 3,180 ICT employment permits were issued — a 27% increase from 2015. In 2017, the number was 3,442 — an increase of 8.2% over 2016.

Against this backdrop, Ireland once again needs to assess the likely future demand for ICT skills so that it can take the appropriate actions to address the needs of its indigenous ICT industry, the large number of MNCs, as well as the requirements for specific skills in the IT departments in the various industry sectors.

## Objectives and Scope

The EGFSN engaged IDC to forecast the demand for high-level ICT skills over the period 2017–2022 arising from the broad ICT sector as well as across other sectors of the economy in terms of the following specific ICT skills:

a)  Computing skills (including computing software engineering and computer programming as well as multimedia gaming with a substantial computing component); and

b)  Electronic and electrical engineering skills (including communications and mechatronics, and electronic/computing engineering)

The scope of the study is for high-level ICT skills, which includes Levels 7–10 plus Level 6 Higher Certificate, awarded by institutes of technology, Quality and Qualifications Ireland (QQI) and some universities. It is acknowledged, however, that the Further Education and Training Sector will play an increasing role in fulfilling the demand for ICT skills- as demonstrated for instance by the focus on developing ICT apprenticeships[4].

The study adopts an EU Eurostat occupational definition of an ICT practitioner, which includes the capabilities required for researching, developing, designing, strategic planning, managing, producing, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems[5]. The approach to arriving at the demand forecast and the associated key study findings has several strands:

- Use of IDC's in-depth knowledge and existing body of research in the ICT markets, including global and regional demand trends and forecasts on ICT spending and end-user surveys, developed and published by IDC's expert analysts

- Interviews with 20 key informants/stakeholders in Ireland from trade associations, government bodies, academia and professional bodies

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[4] See the Action Plan to Expand Apprenticeships and Traineeships in Ireland, 2016-2020-
https://www.education.ie/en/Publications/Policy-Reports/Action-Plan-Expand-Apprenticeship-Traineeship-in-Ireland-2016-2020.pdf
5 https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:E-skills
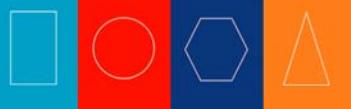
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This research process is combined with IDC's proprietary ICT skills demand model to create the demand forecast presented in this study. This model has been used for more than a decade on behalf of the European Commission to forecast the demand for ICT practitioner skills in Europe.

For this study, this demand model is adapted to reflect the specific Irish conditions. As a small open economy with a strong export focus, a large proportion of the skills needed are not just reliant on demand created in the domestic market. Demand is also strongly dependent on market conditions and demand patterns in the global ICT market, as well as the competition for FDI and availability of skills from other countries and regions around the world.

## Global Technology and Service Trends Influencing Irish Skills Demand

The following section discusses some of the emerging technologies and trends that will be shaping demand for ICT skills over the coming years. Since a large proportion of Irish ICT employment is related to designing, developing and supporting ICT technologies and services that are consumed outside Ireland, this chapter looks at international rather than domestic-only trends. Overall, the worldwide ICT market is forecast to grow by a CAGR of only 3% in the 2016–2021 period, according to IDC's forecast. However, below these topline numbers are strong growth markets for emerging technologies, which are driving fundamental change to businesses and consumers around the world.

These new technologies are termed "Innovation Accelerators", as shown in Figure 4. These are very diverse technologies such as cognitive systems and artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, augmented and virtual reality, and next-generation security. However, a commonality between them is that they are enabled by what is described as the 3rd Platform of cloud, Big Data/analytics, mobility and social media. The previous platforms were client/server (2nd Platform) and mainframe (1st Platform).

The possibilities of how to deploy these new technologies to change business models, innovate products and services, and radically improve customer experiences are only just emerging. But this does not mean that organisations around the world are not thinking about what they can do for their businesses. Research shows that 84% of the CEOs of the FT500 companies already have digital transformation at the centre of their corporate strategy.
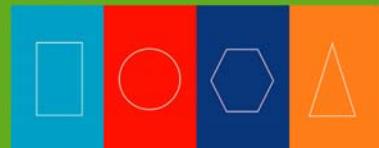
**Figure 4: Emerging Technology Trends**



Source: IDC, 2018

## Digital Transformation

Digital transformation has been a strong theme in both business and IT over the past five years or so— and often a misused term for almost any kind of new technology adoption. However, implementation of new digital technology does not necessarily mean it is digital transformation. There are two characteristics for real digital transformation. One is that the technology adoption must be about transforming the business and not about the technology itself — so digital business transformation would be a much better term. The other guiding principle is that true digital business transformation is an ongoing process that requires cultural change. Because of the speed of technology change, treating digital transformation as a one-off project would mean that in a brief time the organisation would once again be behind competitors and peers in the market. Enter the era of continuous innovation.

The past decade has seen a new wave of information and communications technology "coming of age" and being adopted widely in organisations in Europe (and worldwide). These 3rd Platform technologies are now fundamental to organisations' IT environments. And there is a surge of interest in how to use the Innovation Accelerators. It could be argued that a spate of new ICT coming to market is nothing new — but what is new is how organisations are looking to apply these technologies. They are no longer in the realm of the IT department only and neither are the skills needed for technology adoption. This places even more emphasis on "hybrid" skills — people that understand how to straddle between business and technology.
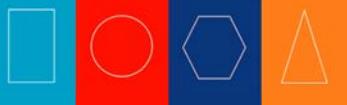
External considerations (improving customer interactions and developing new products and services) are driving the majority of digital transformation strategies at the moment. However, this does not mean that organisations are downplaying the importance of digitising internal processes and operations. The past few years of experimentation have shown that without also addressing the underlying processes that, for example, underpin customer interactions (such as order, payment, fulfilment and return processes) even innovative digital customer experience interfaces will not be successful.

An example of this is a hotel chain that hired a new chief digital officer with a view to improving its customer experience journey. Through discussions with the front-desk staff, it realised that it needed to take a holistic view of the customer journey from booking (which may not be directly with the hotel) through to the stay itself. The chain discovered that it had 200 silos of data that would need to be integrated — so it had to "shift investments from cool gadgets to a strong interoperable platform". Once again, when managing digital transformation, the back-end processes also need to be in the picture- the basics have to be in order for successful digital business transformation.

Some of the key factors for successful business transformation — underpinned and enabled by digital technology — are those that can be found in any ICT project: setting the strategy, designing the solution and planning and implementing the technology. However, a strong understanding of the business and required business process changes are also fundamental in digital transformation, which often lead to development of new business models.

**Impact on ICT Skills Demand**

Digital transformation is more about the journey that an organisation embarks upon to change its client engagement, creating new business models or enabling its employees to work in a different manner, rather than about a specific ICT skill. All of the technology skills discussed below could be applied. However, areas such as creative or design thinking are central to many of the digital transformation activities. Consequently, the past couple of years have seen many acquisitions by IT and business service providers of design agencies to bring these capabilities to clients.

In addition, strong implementation and execution skills are crucial to these often very complex solutions that take organisations into uncharted territories. Speed and agility are also key in most transformation efforts, which leads organisations to adopt agile development methods and a DevOps culture. People with skills that can help along that journey are highly sought after. Furthermore, because the ICT and business linkage is so strong (hence digital business transformation), skills that can understand the required business process change are required for success.

Digital transformation sets new demands on the leadership of the organisations. There has been a wave of new senior positions with titles such as chief digital officer, digital evangelist, innovation officer — and more recently chief digital innovation officer. These roles demand experience and both technology and business capabilities — in other words, real hybrid skills.
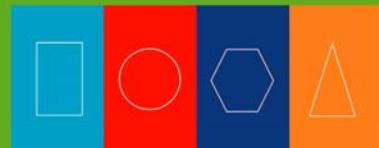
## Artificial Intelligence/Cognitive Systems

Artificial intelligence and cognitive system (AI/CS) technologies started to take centre stage in the past 12 months across the globe and continue to attract new investments and attention from all industries. The AI/CS market is still nascent, but it has immense potential.

It's not that AI/CS is a new technology or topic, but the availability of more flexible, scalable and cheaper computing power, combined with analytics and exploding data volumes, has created an optimum environment for AI/CS to emerge as key technologies of the future. AI/CS is a set of technologies that use machine learning, speech analytics, natural language processing, machine vision and analytics to process the data to make informed decisions or recommendations. It enables discovery, use and collaboration of data in analysis and decision making. Machine learning enables machines to learn from experience on their own. These algorithms are capable of learning from examples and making predictions based on that. This will enable computers to learn, discover patterns, predict outcomes and improve automatically without explicit programming. Most of the leading technology companies, such as IBM, Google and Microsoft, are using machine learning inside their cognitive platforms. Deep learning and re-enforcement learning, which are the subsets of machine learning, are gaining greater importance with the recent advancements in AI/CS research. Machine learning is expected to be a core part of most of the AI/CS solutions in the future.

AI/CS technologies and platforms will continue to expand rapidly in the coming years. Developing and broadening the technology capabilities such as conversational AI, image, audio and video analytics, deep learning and hypothesis generation would be among the key priorities for technology vendors. There is also a growing trend of integrating AI/CS systems with enterprise collaboration tools to add new capabilities and to make these tools more intelligent. This trend will get stronger in the next five years and will lead to massive re-engineering of the workplace to make it more responsive, agile and able to facilitate data-driven decision making across business functions.

AI/CS technologies are poised to transform the way businesses operate. They will free the knowledge worker from the mundane or low-value tasks, to focus on higher-value jobs. The ability of AI/CS systems to process structured and unstructured data inputs makes their applications broader than most of their peer technologies. Companies have already started to engage AI bots at customer touchpoints to handle customer queries quickly and efficiently. These AI systems with natural language processing and generation capability can respond to customers via voice/text channels just like their human counterparts. This will transform the way enterprises interact and engage with customers and deliver services to their end users in the future.

However, only a minority of enterprises have begun to explore the potential of AI/CS technologies, but this is expected to change in the near future as many organisations are currently in the planning or evaluation stage. Potential use cases for AI/CS technologies are broad and vary across different industries. The use cases that attracted the most attention and investment in Western Europe in 2017 include sales process recommendation and automation, fraud analysis and detection, quality management systems, automated threat intelligence and prevention, and IT automation. These five use cases accounted for more than 50% of AI/CS spending in 2017.
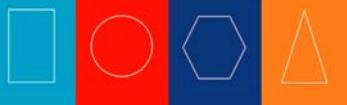
AI/CS technologies have started to make their mark as many organisations seek new ways to reduce the cost to serve, improve time to market and enhance operational efficiency. According to IDC forecasts, spending on AI/CS systems in Western Europe reached €1.2 billion in 2017, an increase of 38.7% over 2016. Spending is expected to continue to see significant growth in Western Europe, reaching €5.2 billion by 2021, a CAGR of 45.3% from 2017. On a global basis, spending will reach €52.1 billion by 2020 with a CAGR of 48%.

### Impact on ICT Skills Demand

The accelerated pace at which AI/CS technologies are growing has created challenges as the growth needs to be supported by the right talent with the required skillsets in this relatively new domain. Many organisations are struggling to meet their demand for AI talent. According to IDC's European survey findings, a lack of suitable talent is holding back AI/CS deployments in many enterprises. Over 30% of the 350 survey respondents cited talent availability (data scientists and engineers with AI expertise) as a major barrier. It is expected to ease in the future as enterprises and universities ramp up the training and development in the relevant areas. A survey conducted by Capgemini[6] across 1,000 organisations around the world supports these findings. Capgemini's report identifies a lack of talent availability as the top challenge in AI/CS implementation. Over 70% of the participants in the survey said they have initiated reskilling and upskilling of their employees to address demand for talent.

Furthermore, data reported by Indeed, a leading online job listing platform, shows the extent of the skills gap in the domain in the UK[7]. According to the report, the need for software developers in machine learning has grown at a massive rate — 485% — since 2014. The report also showed that the number of vacancies in the AI/CS field is more than twice the number of available qualified candidates.

Demand for talent in text analytics and natural language processing, speech recognition, machine learning and deep learning platforms, computer vision, and decision management is becoming more prevalent as the technology matures.

This talent scarcity is a global phenomenon — it is not confined to the UK, Ireland or Europe, and is also visible in more mature markets such as the US. The findings from a study conducted by Paysa — a recruitment platform that uses AI — shows the war for talent among the tech giants and how they poach talent from each other[8]. The Paysa report states that Amazon has hired over 123 people with AI-related skills from Microsoft over a period of five years ending in April 2017, while Microsoft hired over 124 people from Amazon in the same period. Amazon has also lost over 120 people to Google during the same period, while only a few Google employees joined Amazon. This talent war will

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6 Turning AI into Concrete Value: The Successful Implementers' Toolkit, Capgemini, 2017 (https://www.capgemini.com/gb-en/wp-content/uploads/sites/3/2017/09/dti-ai-report_final1-1.pdf)
7 Computer Weekly, "UK at Risk of AI Skills Crisis", October 2017 (https://www.computerweekly.com/news/450427634/UK-at-risk-of-AI-skills-crisis)
8 Paysa, "US Companies raising $1 billion or more to fuel AI development", 2017 (https://www.paysa.com/press-releases/2017-04-17/6/us-companies-raising-1-billion)
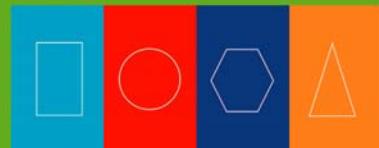
become more aggressive unless universities and enterprises work together to bridge the gap in these skillsets.

Amazon, one of the leaders in the AI space, has announced its plans to expand its AI developments by opening a new research and development centre in Barcelona, Spain, with over 100 software engineers and scientists. Amazon is expanding its R&D base in Europe. In May 2017, the company announced its plans to open a development centre in Cambridge with over 400 skilled employees in machine learning, speech analytics, data science, mathematical modelling and software engineering. Similarly, other technology companies are making their mark in AI/CS and are trying to climb the AI/CS ladder as fast as possible. Figure 5 provides an overview of some of the skills demanded for AI/CS.

**Figure 5: Artificial Intelligence/Cognitive Systems — Skills Impact**
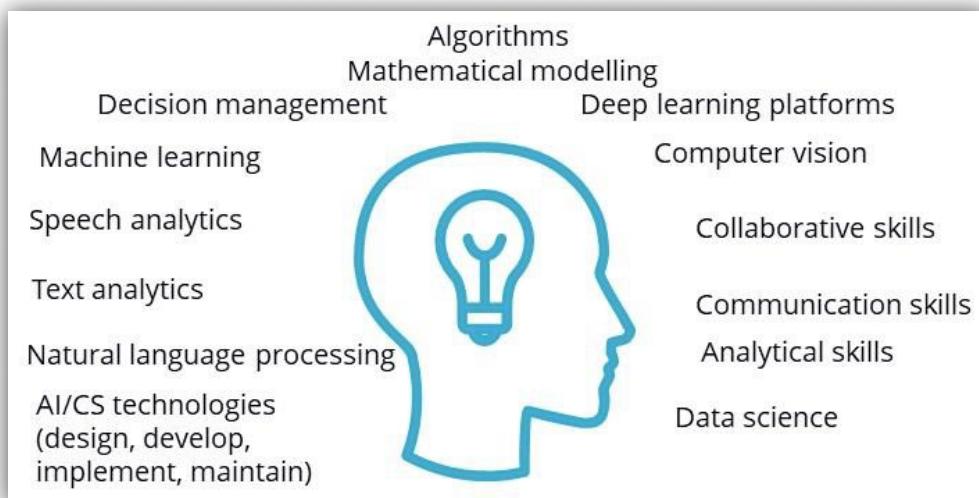


Source: IDC, 2018

## Big Data and Analytics (BDA)

Big Data technology is described as "a new generation of technologies and architectures designed to economically extract value from very large volumes of a wide variety of data by enabling high-velocity capture, discovery and/or analysis". The Big Data and analytics market comprises hardware, software and services, which are closely tied together to derive value from the data.

Increasingly, organisations are realising the value of data and are turning to technologies such as Big Data and analytics to enable them to compete effectively in a highly digitised world. Most European enterprises currently using BDA are found to have a narrow focus and small-scale, limited use cases for BDA deployments. Enterprise-wide BDA adoption is something that many organisations find challenging. However, the emergence of robotic process automation, cognitive platforms, a shift towards cloud models and reduced cost of data storage will enable organisations to deploy BDA at scale in future.
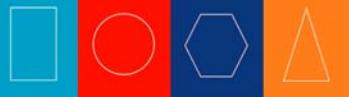
Research indicates that over 60% of European organisations are at some stage of a digital transformation journey and these organisations consider BDA a critical part of their digital strategies. The primary reason is that BDA is essential for real-time decision making, based on the right information at the right time, which is the key to success in the digital world. It enables organisations to become more customer centric, to innovate quickly and to respond swiftly to changing market conditions. In addition, the growth in the Internet of Things (IoT) produces vast volumes of high-speed data that need to be captured and analysed to develop data-driven and digitally enhanced products, services and experiences.

Clearly, the demand for data capturing, management and analysis technologies continues to increase with the growing digitisation efforts in enterprises and the increasing number of data producers, such as IoT. Additionally, the increasing adoption of cloud, mobility and social platforms accelerates the demand for technologies to process structured and unstructured data forms as well as tools for data integration.

Traditionally, most of the BDA software deployments were focused on descriptive analytics — to understand what has happened in the past. But now the focus is slowly starting to shift towards predictive and prescriptive analytics — to answer questions on what could happen and what course of actions need to be taken. These changes in the demand side are forcing vendors to enhance their capabilities to incorporate prediction and optimisation as well as advanced analytics such as machine learning, deep learning, geospatial analytics and self-adapting analytics models.

BDA spending in Western Europe lags the worldwide market in overall growth, with a 2017–2021 CAGR of 9.2% to reach €41 billion, while worldwide spending will grow at a CAGR of 12% over the same period to reach €209 billion. Around 28% of Western European companies are currently using BDA, with most of the adoption coming from finance, telecom/media, professional services and transportation industries with use cases ranging from customer care to network optimisation and predictive maintenance.

### Impact on ICT Skills Demand

Big Data relies on relatively new technologies such as highly scalable relational and non-relational databases (e.g., Hadoop, NoSQL) and advanced visualisation tools, and data analysis and management tools. Consequently, there are very specific technology skills needed but also great demand for a new generation of data scientists to make sense of the vast amount of data being generated. A lack of skills remains a key challenge for enterprises that want to climb the analytics value chain. The EU funded EDISON project[9] came from the realisation that this is a gap that needs to be addressed; this is aimed at speeding up the increase in the number of competent and qualified data scientists across Europe and beyond. One outcome of the project has been that data science now embraces a full range of professions.

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9 http://edison-project.eu/
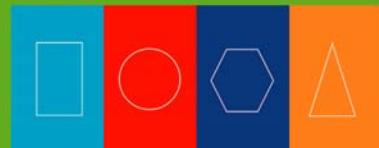
Studies have found that European Big Data users are challenged to find appropriate skills to deploy data lakes to consolidate all the data in one place. Data lakes are often deployed using non-relational technologies such as Hadoop and NoSQL databases and include open source frameworks such as Spark, Hive and R. These are new tools, and database administrators, solution architects and data engineers need to be upskilled or reskilled to handle these environments. Hence, finding and developing the right skills to design, handle and implement data lakes continues to be a challenge.

A recent study published by Harvey Nash and KPMG[10] shows that Big Data and analytics remained the most in-demand skill for 2017 globally, with an increase of 8% from the previous year. Data science, machine learning and advanced data visualisation were the most sought-after skills and demand was projected to grow at a faster pace in the subsequent two years. The lack of these talents could potentially disrupt organisations' ongoing product development and go-to-market strategies. IBM has predicted that the demand for data scientists and analytics will grow 28% by 2020 in the US[11]. Its findings also highlight the problem around talent supply due to the heightened education requirements for some roles. Over 39% of the data scientists and advanced analysts require a master's degree or PhD, and this will add an additional three years to the time required to train and develop a qualified talent pool.

**Figure 6: Big Data Analytics — Skills Impact**
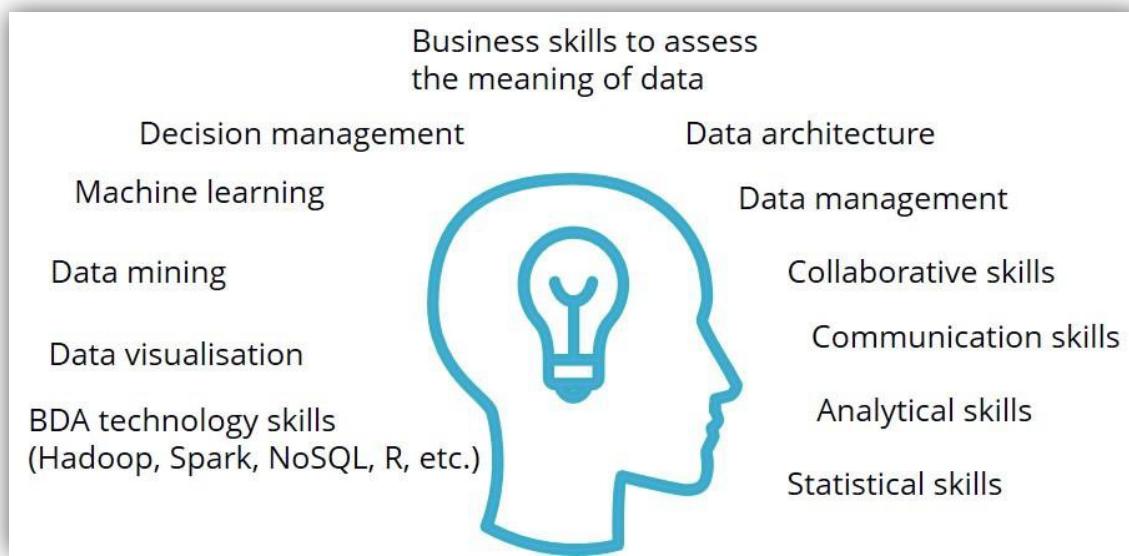


Source: IDC, 2018

10 Harvey Nash/KPMG International CIO Survey 2017 (https://home.kpmg.com/xx/en/home/insights/2017/05/harvey-nash-kpmg-cio-survey-2017.html)
11 IBM, "The Quant Crunch: How the Demand for Data Science Skills is Disrupting the Job Market", 2017 (https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=IML14576USEN)
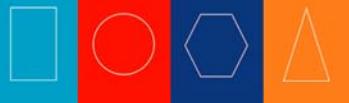
## IT Security

Security continues to be a top priority for European organisations. The growing adoption of new technologies such as IoT, cloud and mobility, coupled with enterprise wide digital transformation initiatives, has made organisations more vulnerable to cyberthreats. Additionally, the emergence of new threats and cyberattackers who swiftly change their modus operandi create new challenges for organisations today. Enterprise investments in security technologies continue to rise, both in large companies from tightly regulated industries and in small to medium businesses from less regulated sectors.

The following are the key factors driving enterprise spending in the IT security market:

- Changing regulatory requirements: New regulations such as the EU's General Data Protection Regulation (GDPR) and Network Information Security Directive (NISD) are creating new challenges for security teams in organisations. Increasing complexity of regulations will make compliance more difficult and this will accelerate spending on IT security technologies and services.
- Enterprise wide digital transformation initiatives: The growing adoption of IoT, cloud and mobility has made perimeter-based security solutions, such as network and endpoint security, less effective. The increasing number of endpoints and the channels through which data flows expose organisations to new threats.
- Evolving threat landscape: The ever-growing sophistication, complexity and velocity of the cyberthreats pose bigger challenges for today's organisations and are forcing them to look for next-generation security solutions to contain cyberthreats.
- General Data Protection Regulation: GDPR came into effect on May 25 2018. This regulation significantly impacts the way personal data is protected, stored and handled within organisations. GDPR regulations will transform organisations' approach towards data storage, management and security. Research estimates that GDPR-related security spending reached €2 billion in 2017, and it is expected to grow to €3 billion by 2019 as many enterprises are actively looking for security solutions to meet the new regulatory requirements.

The growing complexity, frequency and severity of cyberthreats are forcing organisations to explore new ways to safeguard their digital assets. To secure digital assets from new and emerging threats, enterprises need to shift from their current reactive approaches towards security incidents to a more proactive threat management approach. This is where specialised threat analysis and protection (STAP) solutions come into the picture. STAP solutions aim to detect not only the known threats but also the unknown threats within the organisation and prevent them from causing any damage to the firm. This is achieved by using machine learning techniques to analyse the behavioural patterns shown by an unwarranted activity to generate indicators of malicious activities, rather than trying to develop a signature for every single new threat. It is estimated that the STAP market will grow from €179 million in 2016 to €469 million in 2021.

Another fast-growing security segment is managed security services. This market is mainly driven by the shortage of security skills, which forces enterprises to work with third-party security specialists to augment their in-house capabilities and resources.
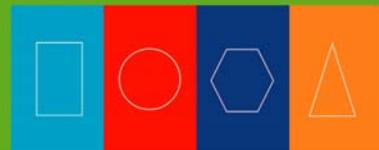
Overall, it is estimated that Western European spending on IT security (including hardware, software and services) will grow from €19 billion in 2017 to €26 billion in 2021 (a CAGR of 8.1%). On a global basis, the market is expected to grow by a CAGR of 9.5% to reach €108 billion in 2021.

**Impact on ICT Skills Demand**

The skills shortage in IT security is felt across the globe, and the gap is widening at an alarming rate. According to ISACA, a non-profit organisation focused on IT governance, there will be a global shortage of 2 million cybersecurity professionals by the end of 2019[12]. This growing skills gap leaves companies vulnerable to cyberthreats. Many organisations struggle to fill the IT security roles.

A 2017 study by Indeed shows that demand for cybersecurity skills is highest in Israel, Ireland and the UK[13]. The study also reveals that the number of candidates looking for cybersecurity jobs reached only 32% of the number of jobs posted globally. There is substantial demand for higher technical skills among enterprises. Demand for skills such as secure software development, intrusion detection, risk mitigation, cloud security, and identity and access management continues to be high in the security market.

**Figure 7: IT Security — Skills Impact**
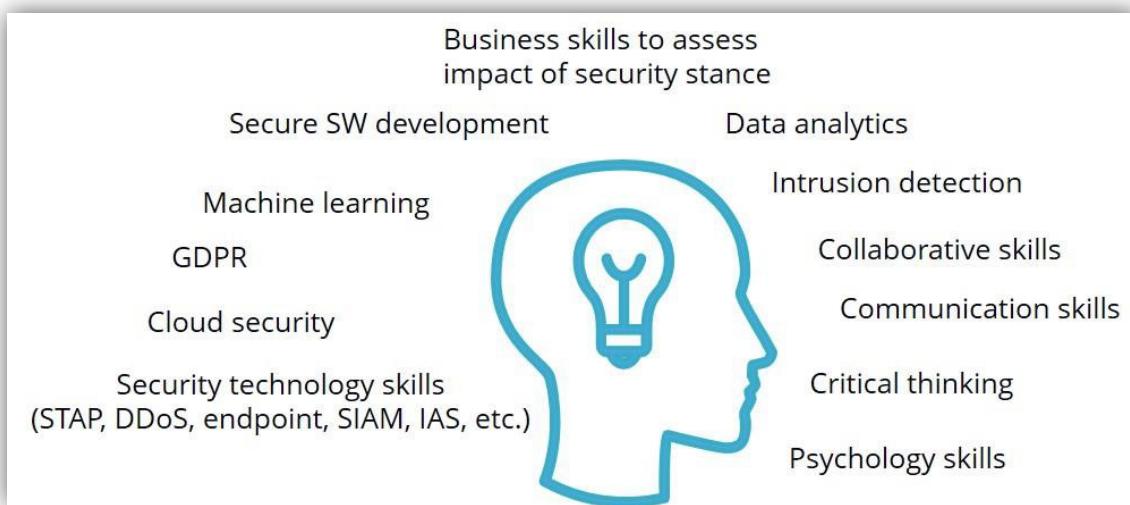


Source: IDC, 2018

## Internet of Things

The Internet of Things is defined as "a network of uniquely identifiable endpoints (or 'things') that communicate bi-directionally using IP connectivity, typically without human interaction. IoT brings

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12 ISACA, 2016 Cybersecurity Skills Gap
13 Indeed, Spotlight: The Global Cybersecurity Skills Gap, 2017 (http://blog.indeed.com/2017/01/17/cybersecurity-skills-gap-report/)
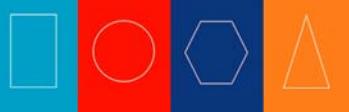
together things, data, processes and people through an integrated ecosystem to make networked connections more relevant by turning information into action.

Proliferation of connected devices, maturing cloud IoT platforms and the strong digital transformation trend fuel growth of the IoT market as does the growing number of connected devices and solutions. It is estimated that the worldwide installed base of IoT endpoints stood at 14.8 billion in 2016, and will grow by a CAGR of 19.4% through 2021 to reach 36.1 billion.

The key emerging themes evolving in the IoT market are:

- Security and openness: Security and openness are intertwined despite their contradictory nature. The growing adoption of IoT devices and connected solutions by both public and private sector industries will expose their IT systems to new vulnerabilities. Yet, these security concerns have not put a brake on IoT adoption but rather need to be addressed as an integral part of IoT deployments.

- Integration and consolidation are central to maximising the value of IoT deployments: In order to increase efficiency and facilitate innovation, IoT solutions need to be integrated with enterprise processes.

- The IoT market is moving to a new phase: The IoT market is maturing and moving from its initial "dash to connect" phase to a more sophisticated phase. In the initial phase, IoT was seen as a tool for data collection only, but this is changing. IoT is now creating transformative opportunities and leading to new value-added services for enterprises. Organisations see IoT as a key enabler of business transformation and an essential component in process optimisation and automation.

A March 2017 survey of almost 800 European organisations ranks IoT as fourth on their priority list of investments.  The top 3 priorities are cloud, analytics and mobility. This underlines the importance of IoT in business transformation in Europe.

It is estimated that Western European IoT market spending will grow from €116 billion in 2017 to reach €209 billion by 2021, a CAGR of 15.9%. On a global basis, the market is expected to grow by a 13.9% CAGR over the period to reach a value of more than €1,026 billion in 2021. Industry-specific use cases from sectors such as manufacturing, utilities and transportation take a major share of the market. However, consumer IoT (such as smart homes and personal wellness) and cross-industry solutions (such as connected vehicles, smart buildings and security solutions) are the fastest-growing markets. Growth is fuelled by the growing adoption of new technologies, coupled with the realisation that IoT adds value to the business, from improving operational efficiency to developing business models.

### Impact on ICT Skills Demand

IoT application design and development is one of the areas where skills demand is expected to accelerate in the coming years. IoT applications with motion-sensing user interfaces and voice-based interfaces are gaining traction across sectors. The emergence of virtual and augmented
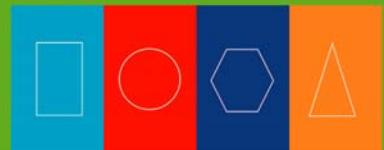
reality technologies will further boost the demand for user interface (UI) and user experience (UX) design skills in the IoT market. The demand for GPS-enabled technology developers is also on the rise with the rapid penetration of GPS technology in smart wearables, and the automotive and transport and logistics industries.

Being a collection of technologies, IoT creates opportunities across the technology spectrum. For example, to make sense of the data collected through sensors and other various endpoints, organisations need to have the right talent to analyse the captured data. But the skill shortage in analytics and data science raises the barriers to IoT adoption across the globe. Also, organisations deploying IoT solutions need to ensure the security of these connected endpoints and the vast amount of data generated through them. This will further boost the demand for IoT security specialists.

Growth in IoT also drives demand for electric and electronics engineers, circuit designers and computer-aided design (CAD) experts that can develop the connected devices, sensors, embedded systems and actuators.

Network connectivity is another important aspect of IoT. Network connectivity enables these endpoints to connect and communicate with each other and with other applications. The rapidly growing number of connected endpoints will drive the need for highly scalable networks, software-defined networks and essential skills around network management and design to ensure seamless connectivity. In addition to network design, developers should be familiar with network transmission protocols and technologies such as nearfield communication (NFC), Bluetooth and WiFi to facilitate the growth and spread of IoT devices.

**Figure 8: Internet of Things — Skills Impact**
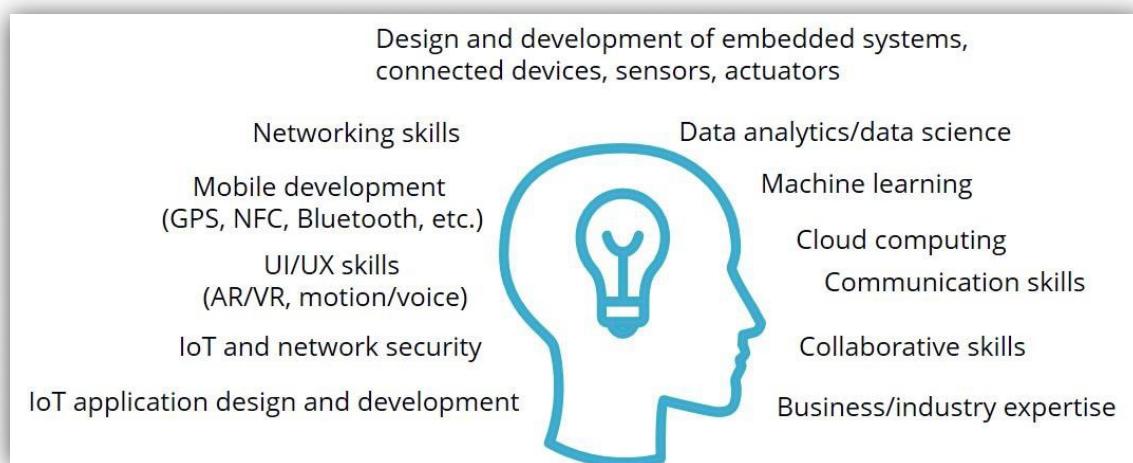


Source: IDC, 2018
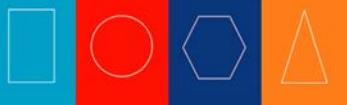
## Cloud Computing

Cloud has been a key area of focus and investment for enterprises around the world for the past 5 to 10 years, and a significant number of European organisations have already shifted to a cloud-first strategy to meet their digital transformation objectives. The need for the IT agility and speed that underpin most digital transformation projects is a key factor triggering European organisations to buy new cloud solutions. Organisations looking to avoid new major capital investments in datacentres or facing major hardware upgrades are also factors paving the way for cloud adoption.

There are two major cloud consumption models — public cloud services and private cloud services. In a public cloud model, cloud resources are shared among different enterprises or consumers, and it is designed for a market- not a single organisation. In a private cloud model, cloud resources are shared within a single enterprise, and it offers greater levels of control and security compared to public cloud.

In Europe, public and private cloud usage is at similar levels, but most organisations are now turning towards hybrid and multi-cloud strategies. Hybrid cloud offers the best of both worlds where organisations can use public cloud for less critical data at a lower cost, while safeguarding their mission-critical data in private clouds. Multicloud is another trend gaining attention — it involves using multiple cloud services at the same time or even different service providers for similar workloads. The multicloud approach offers many benefits such as reduction of lock-in risk with a single mega-platform vendor and the ability to choose cost-effective options for different workloads. This multicloud approach is expected to accelerate in the coming years with the growth in the number and types of public and private cloud providers in the market.

A May 2017 survey of more than 800 European organisations showed that 56% of these are currently using public cloud services. Asking about intentions, the survey indicates that this ratio could reach 80% by 2019, indicating potential for high growth in the next two years. It is estimated that European organisations spent almost €23 billion on public cloud services in 2017 and that this spend could grow to €49.6 billion by 2021, a CAGR of 21.3%. On a global level, public cloud spending is expected to reach €252 billion by 2021 — a CAGR of 20.8% over the same period.

### Impact on ICT Skills Demand

Finding the right talent to effectively exploit and manage cloud investments is constrained by a changing set of competencies and a limited talent pool. Additionally, the increasing sophistication and complexity of the cloud services offered by vendors further aggravates the pain of talent shortages for organisations. Cloud is now a key enabler and platform for many emerging technologies and organisations' digital transformation efforts. Consequently, in most cloud environments, there will be a need for some very complex skills that sit outside the core cloud technology expertise such as cloud- based application design and development, cloud architecture, setting up, orchestrating and managing cloud environments, cloud migration and cloud security. These are hard to find — but critical.
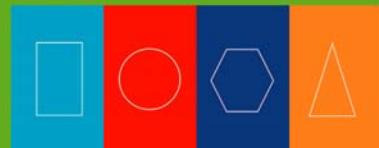
A recent cloud skill survey by Microsoft in the UK showed that over 38% of people involved in recruiting candidates with cloud skills said it was challenging to find the right talent. The study also reveals that a large majority of the enterprises perceive cloud skills as an important element for transformational success — over 80% of the survey participants shared this opinion.

Another interesting finding from a global study conducted by the London School of Economics in collaboration with Rackspace, a managed cloud service provider, shows that lack of cloud skills is costing large enterprises a huge amount of money — over $258 million a year globally as estimated by the study. Also, over 70% of the IT decision makers from across the globe who participated in the study admitted that they have lost revenues due to the lack of cloud expertise.

**Figure 9: Cloud — Skills Impact**
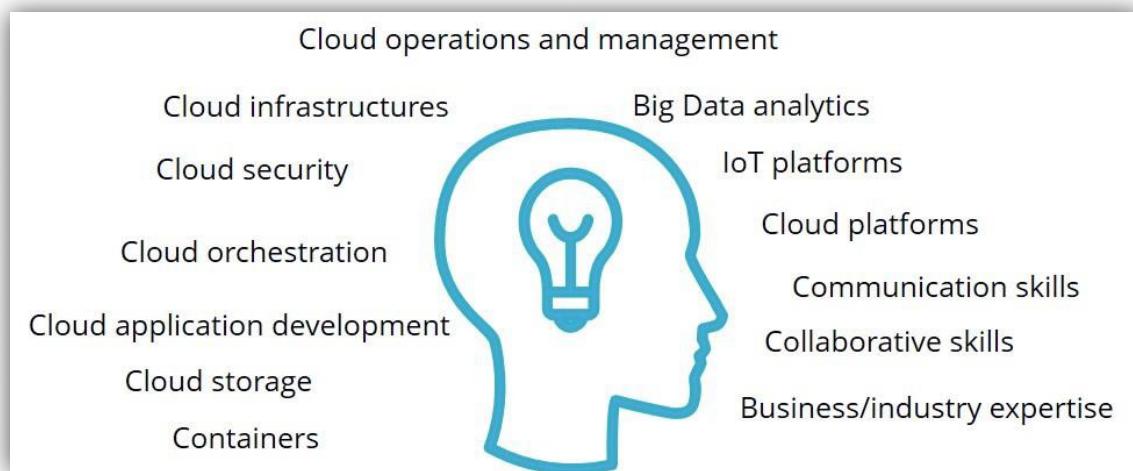


Source: IDC, 2018

## Mobility

Enterprise mobility is becoming a critical element in organisations' digital strategies and transformation projects, where the aim is improving and expanding customer interactions and experiences, partner collaboration or ecosystem involvement, to name a few areas. It is also vital to organisations' digital workspace strategies aimed at enabling employees to work anywhere, any time and with any device or network. Managing mobility solution deployment and security technologies around it has become a mainstream IT issue, rather than a standalone activity as seen before — it is now becoming deeply integrated with the larger IT department in enterprises.

The convergence of mobile devices (smartphones and tablets) with PCs and laptops is a growing trend in the mobility space. The form factors of end-user computing devices are blurring, smartphones are growing to the size of tablets, tablets are evolving with laptop-like features and laptops are evolving to be more like mobile devices. This will force organisations to consolidate management platforms, such as through unified endpoint management (UEM) solutions to secure and control all connected devices from a single console.
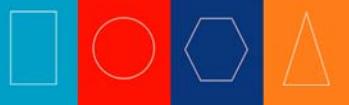
Expansion of mobile technologies in IoT and smart wearables is another trend which is growing strongly in the mobility market. This expansion of mobility into IoT-enabled devices and other connected endpoints will enhance the scope of enterprise mobility management platforms and services.

In addition, mobile application development is a massive growth area and a new trend is the emergence of mobile application development platforms (MADPs). These help (in principle) with simple, easily manageable and cost-effective mobile application development covering all aspects of an app life cycle, from design, development, testing, deployment and distribution, to management and usage analysis. Mobile applications are now a stable in an organisation's application portfolio. Organisations are intertwining mobile applications as part of their key business processes in both the front and back offices, and they are aggressively widening mobility across their application portfolios to accomplish corporate objectives like improving customer experiences, driving higher productivity from employees and enriching data management.

The mobility market is large and hence has not seen as high growth overall as the other markets discussed. It is estimated that European organisations spent €204 billion on mobility in 2017 — this will increase to almost €221 billion by 2021, a CAGR of 2.1%. On a global level, the market is forecast to reach a value of €1,558 billion by 2021, a CAGR of 2.3%.

## Impact on ICT Skills Demand

Findings from a European Enterprise Services Survey in March 2017 of more than 700 organisations, undertaken by IDC, showed that demand for mobile application developers would grow sharply in the subsequent two years. According to the survey, just over 25% of European organisations (a 44% increase on 2016) have mobile-enabled more than half of their business applications. But this percentage is expected to grow close to 50% of European organisations.

Security is perceived as one of the key challenges of mobility, with the higher number of devices and connected endpoints increasing the organisation's exposure to cyberthreats. IT departments will gradually adopt a more multi-layered approach to mobile security as they move up the mobility value chain. Device-agnostic, multilayer security solutions that cover the likes of identity, data protection, application policy and network access control will gain traction in the coming years.

Crucially, a vast amount of new technology solutions have mobility elements included. It is now almost a natural that this is the case. This means that mobility professionals must also understand adjacent technologies for which they will be designing, developing and delivering the mobile interfaces or components.
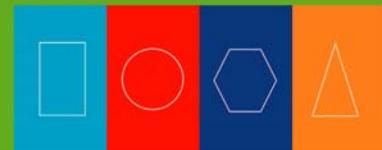
**Figure 10: Mobility — Skills Impact**
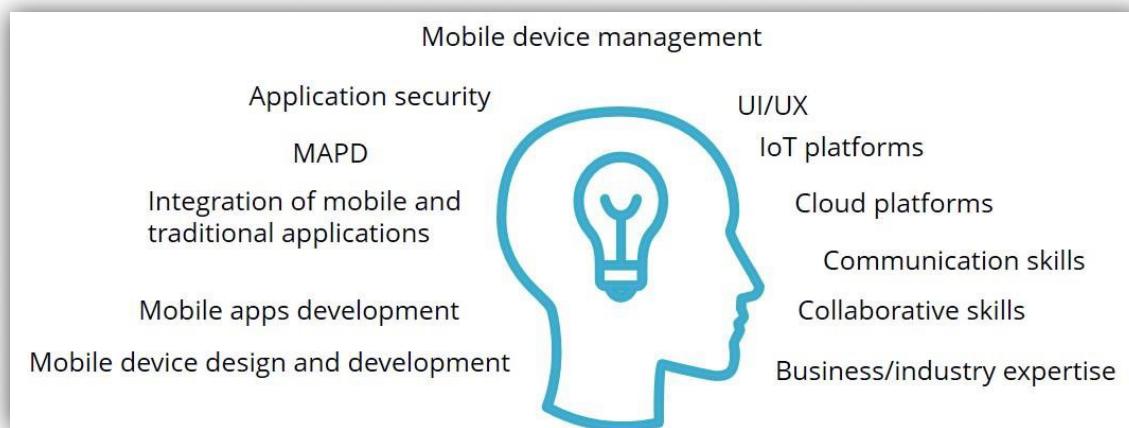


Source: IDC, 2018

## 3D Printing

The 3D printing market is in a period of rapid expansion, and one of the keys to that expansion is growth in the types of build materials that can be used. At the heart of all types of 3D printing are three core materials: solid thermoplastics, powder thermoplastics and photopolymers.

Photopolymers are used in two of the fastest-growing 3D print technologies — stereolithography and polyjet/multijet printing. Solid thermoplastics are the materials used in fused filament (FDM/FFF) 3D printers, which are the most common and widespread, but they typically have the lowest usage rates based on their speed and use cases. Powdered thermoplastics are used in 3D printing processes such as selective laser sintering (SLS) and selective laser melting (SLM). While far fewer 3D printers use these technologies, they tend to be much more production-orientated. Powdered thermoplastics are increasingly used because curing methods using increasingly powerful melting and sintering tools can produce ever-more accurate models and functional parts.

Advances in materials are key to take advantage of cost-saving opportunities. Some of the early adopters of 3D printing systems (such as aerospace and automotive) point to the savings they achieved with the capabilities of new, lightweight and high-strength materials.

From a user perspective, 3D printers are gaining momentum in manufacturing where fast time to market is important and economies of scale are not achievable. Industries such as aerospace, medical, automotive and jewellery are expected to accelerate the implementation of 3D printer technologies.

Parts and products produced by 3D printers will be developed centrally, but manufacturing facilities can be distributed. Some products will be manufactured and delivered faster than traditional manufacturing.

3D printing is a revolutionary technology. Although it is still in its early life, it could potentially restructure the economy as prices decline and technology improves. A good example of this is in the medical field, where 3D printers can create customised implants, helping doctors and dentists carry out complex operations at the same time. In the past, doctors relied on radiographies to diagnose and operate. But today, scanning organs and printing them allows medical professionals to practice before they perform operations. Similarly, dentists can use models that fit in the mouth, enabling them to carry out precise implants and prevent errors.

Worldwide, it is estimated that the 3D printing market will double from €9 billion in 2017 to €18 billion in 2021, representing a 19% CAGR. Growth in Western Europe is lower at 14.2% CAGR, from €2.7 billion in 2017 to €4.6 billion in 2021.

### Impact on ICT Skills Demand

3D printing is often used as a synonym for additive manufacturing — a process by which digital 3D design data is used to build a component in layers by depositing material, as opposed to traditional manufacturing where a product is produced by removing or subtracting material.

From the perspective of developing the actual 3D printers, drivers, tools and applications, this of course requires hardware and software engineering skills. However, because the output from 3D printers as opposed to traditional hardcopy printers is so radically different, it is also important to have 3D graphic artists involved, who know how to create ready-for-print models. This means knowledge of how to use CAD technologies. Obviously, people who design the 3D printers will also need to have an understanding of the core materials being used to create the components. This could have an influence on the design of the hardware and also impact components.

There is a strong trend towards collaborative CAD design, where development and design is cloud based, so cloud skills will also be needed to optimise the performance of 3D print in a cloud-based environment. In addition, networking technology skills will also be needed, as will security skills. Another aspect of 3D printing is that it will change traditional manufacturing processes. End-user organisations looking to implement 3D printing will need assistance in redesigning these workflows — and from someone who understands the possibilities of 3D printing technology. This requires industry and process expertise combined with technical skillsets.
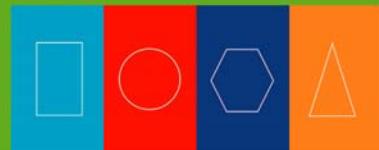
**Figure 11: 3D Printing — Skills Impact**
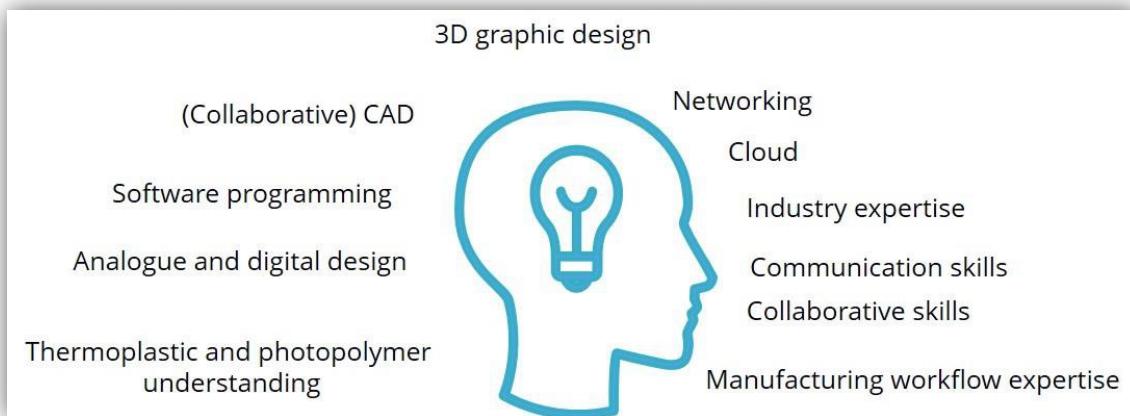


Source: IDC, 2018

## Blockchain and Distributed Ledger Technologies

Over the past few years, blockchain and distributed ledger technologies (DLTs) have gained attention as organisations across a variety of industries look to use DLT to grow revenue, reduce costs, improve business processes and improve financial liquidity.

Distributed ledgers consist of replicated, shared and synchronised data located across multiple systems. Each user has the capability to access and verify the integrity of the data in the ledger. They can also have the ability to add transactions under a specific set of programme rules. This is all done without the need for a central authority to manage and reconcile transaction data. This provides efficient real-time and secure data sharing. It is not important how or where data is stored, but how the consensus is achieved. Hence, distributed ledgers are defined by a consensus mechanism between the nodes. The end result is an immutable and distributed database of digital assets.

Blockchain is a type of DLT. It is a consensus algorithm that contains unchangeable digital data in packages called blocks. These blocks are formatted in a chain of ongoing blocks that contain details on a series of transactions. The data in each block is cryptographically hashed and linked to the previous block. The cryptographic process ensures the integrity of all data in the overall blockchain. Blockchain enables a distributed network of nodes to continuously reach consensus on content of blocks of data. When this algorithm is deployed, the blocks are ordered to form a constantly growing linear chain, where each block is linked to a previous block and can only be appended to the end of the chain. This gives rise to an immutable log of operations that take place during the deployment. Blockchain is the technology behind bitcoin.

Today most of the use cases for DLT enable digital transformation in three areas:
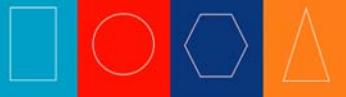
- To secure and validate the "state" of the data and metadata part of an ecosystem. This impacts both technologies (such as cloud, BDA and security) and industries across the board, including e-government, military, supply chains in manufacturing and financial services, and health.

- Compliance, particularly in e-government and financial services.

- Transaction mechanisms for the new digital assets. Examples are cryptocurrencies, international cross-border payments and P2P electric energy exchanges.

Distributed ledger technologies are still at a very early stage across all vertical markets, with just a few forerunner companies testing proofs of concept (POCs), while the majority are still trying to understand what this buzzword means and what it could represent for their business and daily activities. Underlying the differentiating capabilities that DLTs could bring and proving the business case, beyond POCs, will be key to translating an initial interest and appetite into real market opportunities.

It is forecast that the worldwide blockchain market will grow by a CAGR of 79.2% from 2017 to 2021, to reach €8.8 billion. The European blockchain market will grow from €182 million in 2017 to €1.6 billion in 2021 — a CAGR of 72.9%.

**Impact on ICT Skills Demand**

The strong interest in blockchain and DLT has created an explosion in demand for skills in the technologies. According to the Upwork Skills Index, which ranks the fastest-growing freelance job market, blockchain and bitcoin developers were in the top 3 skills demanded in Q3 2017 — only behind robotics skills[14].

**Figure 12: Blockchain and Distributed Ledger Technologies — Skills Impact**



Source: IDC, 2018

14 https://www.upwork.com/blog/2017/11/freelance-skills-upwork-q3-2017/
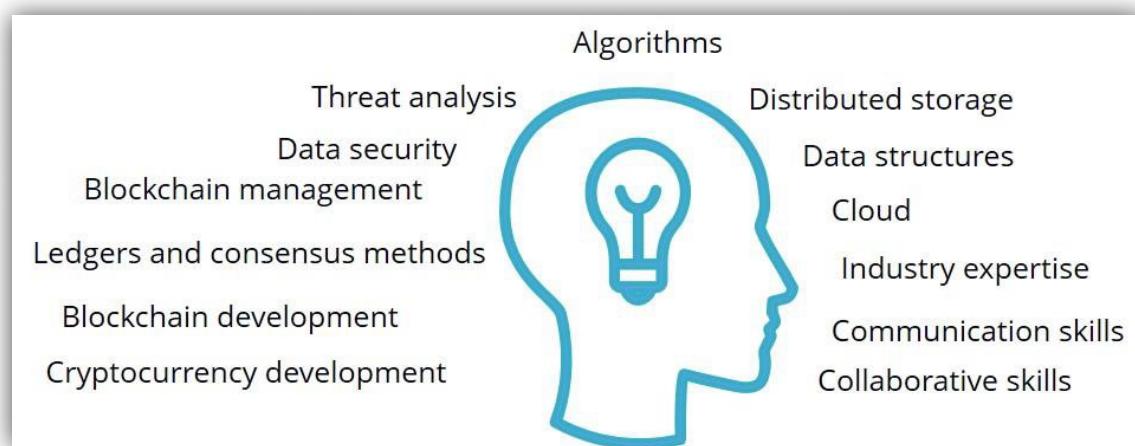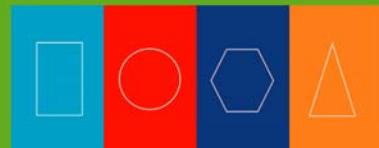
## Micro- and Nanoelectronics as Key Enabling Technologies

Fundamental to the emerging trends above is the development in the electronics industry, including semiconductors. Semiconductor technology has been key in driving the massive improvements in performance (and cost) in computers, smartphones, tablets, servers, game systems and other electronics. For example, the original IBM PC (introduced in 1981) used 16Kb DRAM chips whereas many PCs now have 16Gb DRAM chips, a density increase of about 1 million times (at approximately the same price). Microprocessor performance has similarly also increased by about a million times since then[15]. Much of the innovation in ICT has also been based on developments in semiconductors and microelectronics, such as:

- Cloud computing, through application-optimised semiconductor technologies to optimise performance, integration and power efficiency
- Mobile devices, such as smartphones because of the high degree of chip integration, and development of sensors, touch controllers, etc.
- The Internet of Things via enabling devices for the likes of smart health, smart grids and smart cities
- Artificial intelligence — most of the core algorithms for AI and machine learning (e.g., neural networks) were developed several decades ago, but only recently has processor performance reached the point to make neural networks commercially advantageous

According to Statista, the semiconductor market was worth an estimated $409 billion in 2017. Microelectronics is seen as a strategic growth area in the European Union. Europe accounts for about 50% of the global production of electronics for the automotive sector and around 40% of global production in energy applications, and is strong in the design of electronics for the mobile telecommunications sector, for health implants and sensing technologies[16].

### Impact on ICT Skills Demand

The rapid developments in micro- and nanoelectronics increase the demand for a range of engineers with strong core engineering skills. At the same time, software development skills, which ensure that applications and solutions can take full advantage of the new core enabling technologies, will be needed. These developments drive demand for more of the following ICT skills:

- Electronic engineers with strong core engineering skills to work as chip designers, test engineers and application engineers
- R&D skills for the development of heterogeneous hardware and software architectures, harnessing existing competencies in both hardware and software to develop architectures that are aligned with requirements in key industries such as automotive, healthcare and energy
- R&D skills to develop software that takes full advantage of new enabling technologies and components

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15 Menalto Advisors Thought Report: An Overview of the Semiconductor Industry, 2018
(http://files.constantcontact.com/3cfe0f61601/874e6312-cd99-435e-ac30-5df787327c54.pdf)
16 A European Strategy for Micro- and Nanoelectronic Components and Systems, COM(2013) 298 Final
(http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=2138)
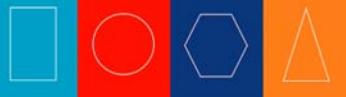
**Figure 13: Micro- and Nanoelectronics — Skills Impact**
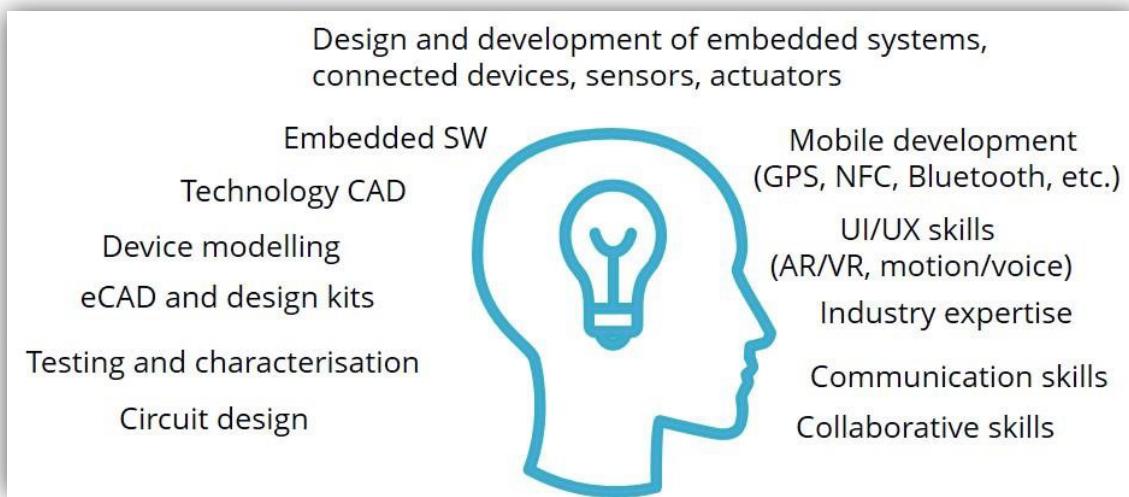


Source: IDC, 2018

## Impact of Global Sourcing and Other Service Delivery Changes

Global sourcing has been a strong competitive factor in the ICT market in the past couple of decades, both for developing, maintaining and running ICT environments as well as outsourcing of R&D, software development and business processes to locations with a lower cost point.

It is estimated that the worldwide offshore IT and business process outsourcing services market had a value of €77 billion in 2017 and will increase to €104 billion in 2021, with a CAGR of 7.7%. The bulk of these services in 2017 (63%) were captured in the US, while Europe contributed to less than 30%. This geographical split will not change dramatically in the short term: by 2021, the US will still account for the largest share of spending and Europe will remain the second-largest region.

India remains the leading country for global sourcing due to the very large number of skilled resources in the ICT sector in the country and the continuous supply of ICT graduates. However, other countries have also entered into the competition for ICT work, including China, Russia, the Philippines, Brazil and Morocco. Inside Europe, Eastern European countries such as Poland, Hungary and Romania are offering themselves up as nearshoring locations — and Ireland plays a key role here too. Ireland has been a key location for delivery of global business services since the early 1990s — well before many other countries offered up their services. This long-standing track record, combined with a highly skilled workforce and a low-risk geopolitical environment, are among the differentiators. As a result, the sector employed 44,000 people in Ireland in 2016 in foreign-owned as well as Irish-owned companies. However, the strong emergence of robotics process automation is having an impact on the global sourcing market.
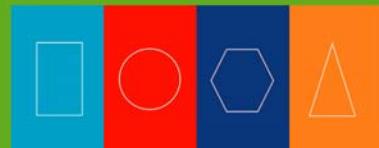
There have been two main drivers behind the global sourcing wave: access to skills that were otherwise in short supply, and the cost of service delivery with the cost factor weighing heavily both for ICT user industries and the ICT industry. However, with increased automation, cost savings are no longer such an important reason to use an offshoring location. Much of their competitive advantage was down to labour arbitrage. There is a real concern in India that the success of its ICT outsourcing industry will suffer. There have been estimates of 70% of the workforce in the country becoming irrelevant in the next year due to automation.

Although this may be a dramatic estimate, there are already signs that something is afoot. According to an article in Quartz India in December 2017, there had been more than 56,000 layoffs in the IT industry in 2017, while at the same time hiring had plummeted. Anecdotally, a large global services firm told IDC that it had taken 35,000 people out of its offshoring network due to automation — but had retrained/reskilled these people rather than let them go. This latter point is important. While there is no doubt that automation will affect employment, it is much more likely that we will see job roles change and large-scale reskilling/retraining activities to take advantage of the experience of the people affected to fill the gaps in other areas.
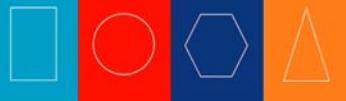
# Chapter 2: The Views from Stakeholders

A key objective of the research was to obtain input from stakeholders. This was done in two ways, by conducting interviews and by holding workshops in both Dublin and Cork. The interviews were structured as follows:

- Key informants — 20 interviews
- Enterprises — 40 interviews

The target list for the key informant interviews was drawn up by the Expert Group on Future Skills Needs Secretariat and included representatives of many stakeholder organisations. These included people with a range of qualifications and expertise from academic institutions, government agencies such as IDA Ireland and Enterprise Ireland, industry representative bodies, and other individuals selected because they have a view on the demand for the ICT skills area across the industry as a whole or in one particular part of it. These in-depth interviews were conducted by phone or face-to-face with the questioning being primarily qualitative in nature.

The target list for the enterprise interviews was produced by drawing on a number of sources. IDA Ireland provided a list of its client companies that had agreed to participate in the research. This included a mix of enterprises of different sizes and from a variety of locations in order to ensure representativeness. In the same way Enterprise Ireland provided a list of its clients, varied in size and location. This was supplemented by a further list of organisations, from both the public and private sectors, which employ significant numbers of personnel with ICT skills. All enterprises on the target list were contacted by IDC for an interview. This process continued until the target number of 40 interviews had been achieved, while efforts were made to ensure a good level of representation of global multinationals, indigenous companies and organisations that, though not in the ICT industry, employ significant numbers of personnel with ICT skills. This was to ensure that a complete picture was obtained of market demand for ICT skills not just from organisations in the ICT industry but also from other industry sectors.

Of the 40 enterprises interviewed, 10 have fewer than 100 employees, 14 have 100–1,000 employees and the remaining 26 have over 1,000. By location, 17 enterprises are primarily based in Dublin, five are in Cork, four in Limerick, two in Galway and six in other locations, while a further six have significant operations in more than one location. Finally, the total number of ICT professionals employed in the enterprises interviewed was 10,960, or around 13% of the total ICT employment in the country. These interviews were conducted by phone or face-to-face, with a mix of quantitative and qualitative questioning.
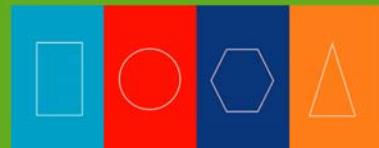
## Enterprise Interviews — Results and Analysis

A total of 40 interviews were conducted with enterprises. A key objective of these interviews was to quantify current and likely future demand for ICT skills within each organisation. For this reason, each respondent was asked to say how many employees the organisation have in the Republic of Ireland and how many of these are ICT professionals according to the definition below.

High-level skills were defined as:

- Computing engineering skills (including computing software engineering, computer programming and multimedia gaming with a substantial computing content)
- Electronic and electrical engineering skills (including communications, mechatronics and electronic/computing engineering)
- The above skills with additional business/analytics/language skills
- The above skills at NFQ Levels 6/7 and 8/9/10

The table below shows the combined responses from the 40 organisations. This demonstrates that although the ICT industry employs significant numbers of people the majority do not fall under the definition of high-level ICT skills. In areas such as customer support and sales/marketing there may not, in some organisations, be a requirement for high-level ICT skills while in others some or all of such skills/qualifications may be necessary.

The figures also demonstrate the relative size of the computing and electronic/electrical segments of the ICT skills sector with the number of professionals in the latter category making up just 10% of the combined ICT skills total in the enterprises interviewed.

**Table 1: Total Employment and Number of ICT Professionals in Enterprises Interviewed**

| | |
|---|---|
| Total employees within enterprises surveyed | 57,032 |
| Number of computing professionals | 10,960 |
| Number of electronic and electrical engineering professionals | 1,251 |
| Total ICT professionals | 12,211 |

n = 40

Source: IDC, 2018

## Challenges in Acquiring ICT Skills

During the course of obtaining quantitative input from each organisation about its ICT skills personnel, many respondents reported having vacancies at present for specific skills. Others had experienced difficulties during their recent recruitment campaigns. To investigate this fully respondents were provided with a list of challenges they may face when trying to recruit people with ICT skills and asked to say which were the top challenges. The distribution of responses can be seen in the figure below.

**Figure 14: Challenges in Acquiring ICT Skills**
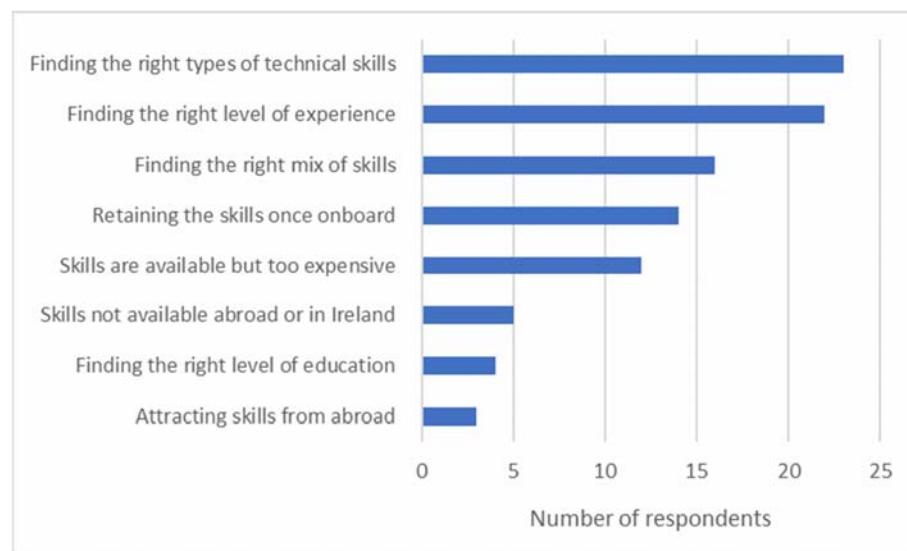


n = 40

Source: IDC, 2018

Finding people with the right types of technical skills was the most commonly mentioned challenge, closely followed by the difficulty in finding people with the right level of experience. When this research was conducted previously in 2013, a major issue was the lack of availability of graduates in various ICT disciplines. Now that the graduate supply has improved the most sought-after personnel are those with five or more years' experience, and respondent organisations say it is hard to find them.

A number of reasons were outlined by organisations that are finding technical skills difficult to find. In many cases the difficulty is because the technical skills being sought are in very new areas or disciplines and therefore are in short supply. Examples are artificial intelligence, machine learning and, even more recent, blockchain and robotics. Demand is high for the small number of people with these skills. Cybersecurity is a discipline where demand so outnumbers supply that new creative methods are being employed to upskill people from different backgrounds with the necessary skills.
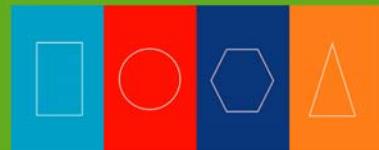
*"It is hard to find people with disruptive tech skills like blockchain, AI, machine learning, RPA (robotics) ... also there will be huge demand for these when they do become available. It is very likely we will be going abroad for these skills."*

*(ICT, Multinational)*

Organisations that operate in niche areas of the ICT industry such as animation and gaming are also finding it difficult to identify and recruit people who are skilled in the specific software programmes used in their sectors. On the electronic/electrical engineering side a key issue is that the pool of people with the required skills is small. A key challenge for some of the organisations in this sector is to get people with sufficient experience, such as at PhD level.

The scarcity of people with the right level of experience is the second-biggest challenge according to the interviews and is common across all parts of the ICT industry.

*"The key challenge is getting people with experience — 5–7+ years in the industry working with different systems. These are hard to find in Ireland and everyone is fighting for the same talent pool."*

*(Electronics, Indigenous)*

Another challenge for respondent organisations is finding people with the right mix of skills. The required mix varies across the industry. In the electronics industry it could be a combination of basic electronics skills with knowledge across the disciplines of electrical/mechanical engineering and software, for example.

However, the mix of skills that is most sought after and cited by many organisations is the combination of technical skills with communication skills (and business acumen) to allow people to communicate effectively with customers. While this issue is third in ranking, there was a great deal of similarity in the comments made by respondents.

*"The key for us is the mix of technical skills with the communication skills required to communicate with a customer at a high level and get to grips with a special domain very quickly."*

*(IT, Indigenous)*

*"Our people need to be able to create a solution for customers. It is not possible for someone to come in with a marketing qualification to come in and learn the tech side. Very deep tech-side ability needed and business experience." (Computing, Multinational)*
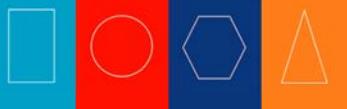
*"We need candidates who can have a technical conversation but can also understand the client's business challenges and how to marry our technology to meet these challenges."*

*(Computing, Multinational)*

Many respondents cited the issue of skills retention as a challenge and it is one that seems to impact the small organisations most, many of which are indigenous Irish. In many cases a company looking to recruit will target one person in a firm, hire that person and then seek their advice on further hires. In this way organisations can lose multiple people or whole teams to a rival company that is prepared to pay more. Clearly, such practices lead to wage inflation in the sector as well as having an adverse impact on the firm losing the skills.

It is also worth noting that virtually all respondent organisations have hired people with ICT skills from abroad in recent years and expect to do so in the future. This represents a major change from when this research was done in 2013 when it was much more difficult to secure work permits for people from outside the EU. The greater availability of work permits has had a major impact on facilitating growth in the ICT industry in the intervening years and will continue to do so.

Finally, a small number of respondents mentioned one other challenge that was not included in the short list provided — the difficulty in attracting people to work in locations other than Dublin. This is less of a concern for companies in Cork, Limerick and Galway, but for smaller towns it is a challenge. The majority of young people want to live in an urban environment and also recognise that this provides them with greater opportunities if they wish to change jobs at any stage.

## Barriers to and Drivers of Demand for ICT Skills

Prior to specific questions on the level of demand each respondent organisation would expect to see in the coming years this was put in some context. Respondents were asked to say what are the main drivers or barriers they expect to affect their level of demand for high-level ICT skills in the next two to five years.

Market demand trends were cited by the majority of organisations as the key driver with almost all experiencing a good level of demand at present for their products and services. The majority also considered that this was likely to continue in the short to medium term at least. It should be noted that those organisations that did not specifically cite this as an issue are still subject to market demand trends but are suggesting that it is not a key driver or barrier for their Irish operation.
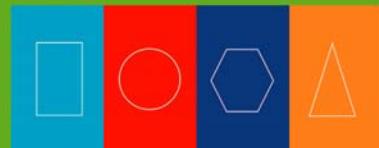
**Figure 15: Barriers to and Drivers of Demand for ICT Skills**



n = 40
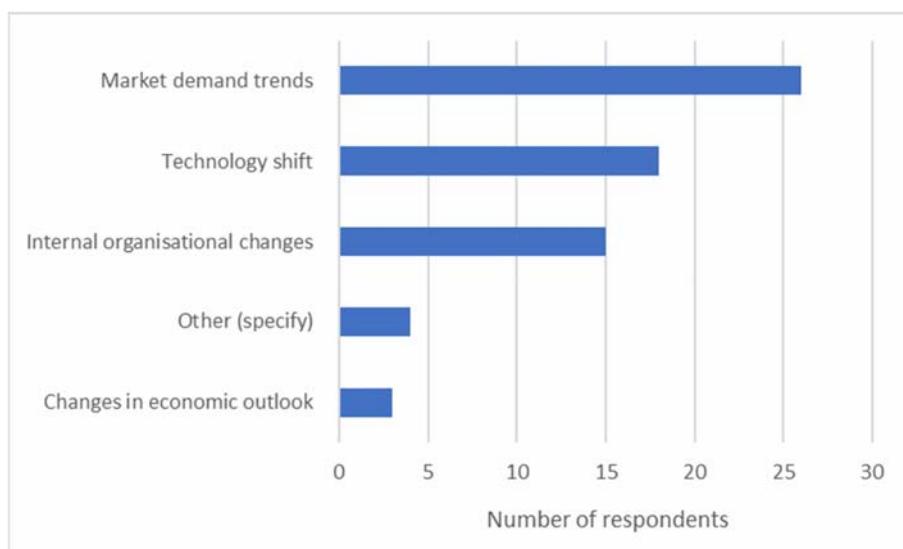
Source: IDC, 2018

The trends among respondents in the computing side of the industry were consistently positive with regard to future market demand trends while the outlook from those on the electronic/electrical side was more nuanced. Some references were made to the cyclical nature of the semiconductor market, which rarely sees a prolonged period of growth without a downturn.

Second to market demand are the technology shifts that are taking place in the ICT sector. The move to cloud computing, for example, is having an impact on many respondent organisations.

As well as the move to the cloud there are now a host of technologies being used in the digital transformation of organisations. This can result in opportunities or challenges or, in most cases, both together.

*"The technical skills required are shifting towards digital transformation, data science, AI and machine learning, and that will require more of these skills than we currently have."*

*(Business Services, Indigenous)*

*"In our market the skillsets required to differentiate our products are getting harder to find. AI and machine learning are being used to do this and finding those skills is a challenge."*

*(IT, Indigenous)*
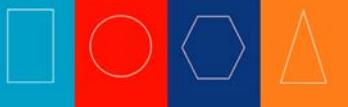
One of the most interesting things that can act as a driver of or barrier to organisations in the ICT industry is the impact of internal organisational changes, particularly in the case of foreign multinationals with operations in Ireland. The impact can be very varied though for different firms.

In many cases the Irish operation of a major global multinational competes, in some ways, with the company's operations in other countries and regions of the world. For example, when a new technology comes along, the Irish operation may seek to become a research and development centre for this technology within the company. The existence of R&D tax credits makes Ireland an attractive location for this. In addition, the Irish operations of global multinationals tend to have a good reputation for the quality of ICT skills availability when compared with other locations. For these and other similar reasons many respondents suggested that internal organisational changes could have an impact on their demand for high-level ICT skills in the next two to five years.

*"We are in what is considered a very attractive location within [the global organisation]. So while we will always be subject to competition particularly from Eastern Europe, the R&D credit helps to make up the cost gap."*

*(Computing, Multinational)*

*"Cork has recently been chosen as the location for new technology in the artificial intelligence area."*

*(Computing, Multinational)*

On the other hand, internal decisions could be made by organisations that would result in a reduction in demand for skills by the Irish operation.

*"With a large number of employees currently, the global organisation might look at Ireland as a small country with little potential for further growth in the operation. It might get a little bigger but beyond that the company would conduct a big examination where things like housing pressure and talent pool would be looked at. At that stage it might look at different countries." (Computing, Multinational)*

*"We have been based in Ireland for many years. But as the company develops in other parts of the world there will be competition for the Irish operation of the company. Ireland has been the talent hub for the company, whose mission is to hire talent, develop it and export it, basically to seed other locations. That is a challenge."*

*(Computing, Multinational)*

The importance of growth for the Irish operations of global multinationals was also noted by some respondents. If the Irish division of the company is not growing in headcount and, therefore, in importance, then the operation could be at risk of closure.
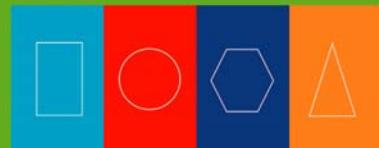
Finally, it should be noted that a small number of indigenous Irish firms indicated that their recruitment strategies have seen them locating skilled personnel outside Ireland and that this may continue.

> *"In the next five years part of our recruitment strategy will be global and this is driven by the lack of availability of resources in Dublin. We will still hire in Dublin but it will be part of global strategy."*
>
> *(Computing, Indigenous)*

## Future Skills Demand

We now move to examine the likely demand for ICT skills at the individual organisations interviewed. Each organisation was asked whether it expected to see a change in its level of demand for high-level ICT skills in the next two to five years. In the vast majority of cases (35 out of 40) respondents indicated that they expect to see an increase in demand for ICT skills during this period from within their organisations. It should be noted that of the five respondent firms that did not specifically forecast an increase in one case only has a decision been made not to increase headcount in Ireland.

**Figure 16: Future Change in Skills Demand**



n = 40
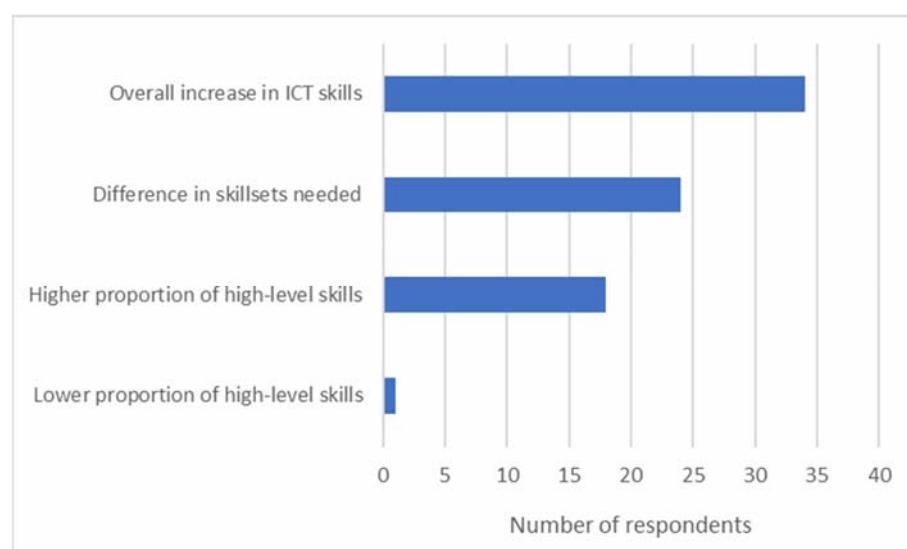
Source: IDC, 2018

Respondents were also asked to estimate the extent to which this extra demand would result in an increase in their employee levels of personnel with high-level ICT skills. The findings have been used as input to the demand forecast which is addressed elsewhere in this report. From the sample of 40 enterprises the total expected growth from 2017 to 2022 in ICT skills employment is 8.6% CAGR.
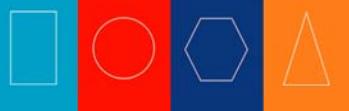
The majority of organisations expect to see some change in the skillsets they will be seeking during this time. As might be expected, many plan to hire more people with expertise in new technologies such as artificial intelligence, machine learning, data analytics and blockchain. However, for the majority, the essential skills — in computer engineering or electronic/electrical engineering — won't change other than in line with industry trends, such as trends in programming languages. The move to cloud computing will have greater skills implications for some companies than others.

*"There will be shifts in programming languages according to fashion.*
*Major shifts will be cloud-related — i.e. how apps are built. DevOps will be*
*a key area." (Computing, Multinational)*

Many respondents expect to hire more cybersecurity personnel as digital transformation proceeds over time, while many also expect to hire people with data science qualifications. Some of the electronics firms suggested they would need to hire more software skills in the coming years. Overall, however, while some trends are identifiable, as outlined above, different organisations have different requirements depending on their specific situation. One major indigenous software firm plans to move up the value chain.

*"To move up the value chain we will need to hire more technical architects,*
*data analysts, and systems designers and fewer core developers."*
*(Computing, Indigenous)*

*"Yes, it is changing all the time — languages used are changed — less and*
*less pure coding — greater understanding of integration of tools will be*
*needed rather than pure development. In the industrial space there will be*
*more automation, IoT, etc." (Electronics, Multinational)*

Many organisations expect that their high-level ICT skills employment will increase as a proportion of their total employment in Ireland, while others believe that overall growth will continue by the same measure.

## Sources for Hiring New Skills

So far the research suggests that demand for ICT skills, already high, will increase in the years to 2022. Where will these skills be sourced from?
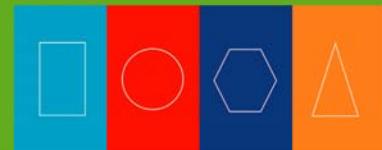
**Figure 17: Sources for Hiring New Skills**



Horizontal bar chart titled with x-axis "Number of respondents"

| Category | Number of respondents |
|---|---|
| Experienced people from other organisations | ~36 |
| New high-level ICT third-level graduates | ~35 |
| From abroad | ~28 |
| Self-taught people w/o qualifications | ~15 |
| Level 5 certifications | ~12 |
| Experienced people from other industries | ~6 |

n = 40

Source: IDC, 2018

Respondent organisations were asked about their plans for hiring, upskilling and outsourcing. Clearly all organisations that expect to increase their employment levels indicated they would be hiring. The majority of organisations also have plans to upskill their existing workforces and this has become more of a pressing need because of the lack of people with experience.

The extent to which organisations are formalising their upskilling programmes is increasing too, noticeably since this research was last undertaken in 2013. Many firms use partnerships with external organisations to assist them, such as colleges and universities, Skillnet Ireland, training firms or vendors.

*"We have strong cross-training and work-shadowing programmes that allow people to move around. We will depend on this for more of our hiring. We work with a university on this."*

*(Finance, Multinational)*

In other firms the process is more informal:

*"We do 'on the job' mentoring and if needs are identified then we send people for training."*

*(Computing, Multinational)*

However, formal programmes are not restricted to global firms:
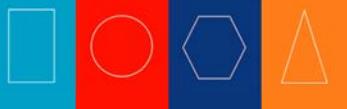
*"Yes, this is a constant process. For graduates we have designed a two-year development programme focused on management and leadership skills. There is a focus also on technical certifications."*

*(Computing, Indigenous)*

Respondents were also asked to what extent they currently outsource to other firms and what their future plans are in that regard. Around a third of the organisations interviewed do some outsourcing, ranging from the use of a few contract staff to having a formal agreement with an offshore partner involving the use of hundreds of personnel.

*"We have some small projects going in China. They are looking good at the moment and we will likely do more there. We are overstretched at present so we could develop the Chinese angle as well as doubling our workforce in Ireland." (Computing, Indigenous)*

Another respondent alluded to some of the drawbacks of outsourcing.

*"Yes, we have contractors in India. Staff t/o is a big problem, and IP protection. My section of the company has the equivalent of 15 FTE contract staff, mostly software."*

*(Electronics, Multinational)*

In the discussions with enterprises there is no sense that any organisation plans to engage in large-scale outsourcing to solve the problem of the scarcity of skills. There was no sense that the Irish operations of any organisation would be negatively impacted in this way.

Moving on to look at hiring plans in more detail, respondents were asked where they expected to find new hires. The vast majority of organisations are planning to hire a mix of graduates and personnel with more experience from other organisations.

Virtually all organisations take in some graduates every year. When this research project was done in 2013 the industry was more reliant on home-grown talent, so the scarcity of graduates was a major issue. Two things have changed since then. Firstly, the supply of graduates has improved considerably and it is clear that many of these organisations have forged closer links with universities both in Ireland and, in one case, abroad. In some cases, the company may have some influence on the content of college courses and in other cases it may ensure a healthy supply of graduates with the right skills. Some companies are taking students on internships to help identify suitable personnel to hire on graduation. The research shows that the organisations interviewed will hire graduates in the coming years and the that vast majority of these will be from Ireland, or at least have graduated from Irish colleges and universities. It is also clear that some companies, particularly some of the larger ones, will focus more of their hiring at graduate level with the aim of developing the skills they require over time to address the scarcity of people with experience in specific ICT skills.
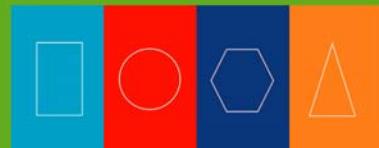
*"Generally, we have around 20 interns per year. From those we hire 6 to 10 depending on how good they are. We will continue with this. Junior people take a while to get up to speed."*

*(Computing, Multinational)*

Though the pool of graduates has increased the fact that it was low in previous years has resulted in a lack of personnel with many years' experience. This is why the vast majority of organisations that have hiring plans expect to be hiring people from abroad. This will take different forms depending on the size of the company, the number of people it needs to hire, the nature of the job specification and the scarcity of supply.

*"70% will be grads — around 60%–70% from Irish colleges."*

*(Computing, Indigenous)*

Some companies will undertake a formal programme of recruitment inside and outside Ireland in search of specific skills. Others will advertise in Ireland but in the knowledge that candidates from other countries will apply for these roles.

*"All of my senior ICT team are from abroad but were not recruited from abroad." (Business Services, Indigenous)*

All respondents were asked to what extent they were interested in hiring personnel with lower-level qualifications or who had obtained their qualifications or skills through conversion courses. People with Level 5 ICT qualifications were of interest to a minority of organisations but people who were self-taught and did not possess formal qualifications were of greater interest. Many organisations cited their experiences of taking people from the JobBridge scheme and from Springboard/conversion courses. In a number of cases, however, these personnel had already gained post-course experience prior to being hired by the company. In other cases they were hired into roles that would not be considered high-level ICT skills by the definition used in this research.

However, there are some key target areas for people with skills obtained in this way. The public sector has difficulty competing with the private sector for people with high-level ICT skills for reasons of costs primarily but not exclusively. This sector is very interested in seeking to recruit personnel from outside the third-level education system and is particularly interested in the new ICT apprenticeship scheme which started up recently and which had its first intake of apprentices in 2018. Similarly, the difficulty in finding personnel with the ICT skills necessary to provide IT support for organisations had led some of the larger respondent companies to seek to recruit personnel based on their professional certifications rather than formal educational qualifications. This focus on skills as distinct from qualifications is likely to continue and increase.

*"We have hired people with certifications (e.g., Cisco, Microsoft) and this is becoming much more prevalent."*

*(Finance, Multinational)*
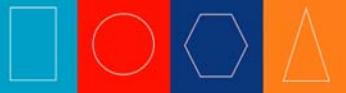
## Measures and Actions to Improve Skills Availability

In the final section of the interview, there was a focus on the measures and actions that might be taken to improve the availability of ICT skills in Ireland, and who should be responsible for taking these actions.

**Figure 18: Improving the Skills Balance — Who Should Take Action?**
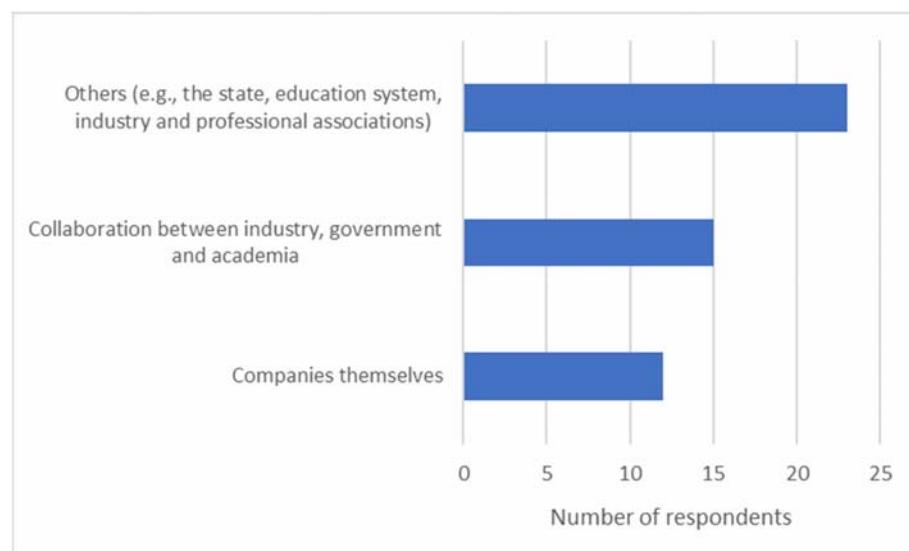


n = 40

Source: IDC, 2018

As the chart below demonstrates there is a mix of opinions on who needs to lead the way in improving skills availability. However, the majority of enterprises interviewed believe it is primarily for the state, the education system and industry and professional associations to take the lead in taking these actions. Many of the issues identified are such that only the state and its agencies can really address them. Things like housing availability, infrastructure improvements and changes to the education system were all identified as issues and they cannot be addressed either by the companies themselves or by working in partnership with other agencies. For example, they are addressed by the IDA Ireland strategy for 2015-2019, which is targeting an increase of 30%-40% of investments attracted to all regions outside Dublin, and the National Planning Framework "Ireland 2040", which plans for fast population growth mainly outside Dublin and the provision of public investments to address the public infrastructure deficit.

## Areas to Improve for Better Skills Balance

As might be expected each enterprise respondent had his or her own view on what measures need to be taken to improve the availability of ICT skills in Ireland and some of these are reflected in the
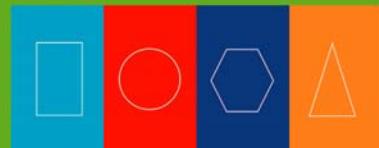
quotes below. However, there are some common themes, and these are reflected in Figure 19 below.

**Figure 19: Areas to Improve for Better Skills Balance**



n = 40
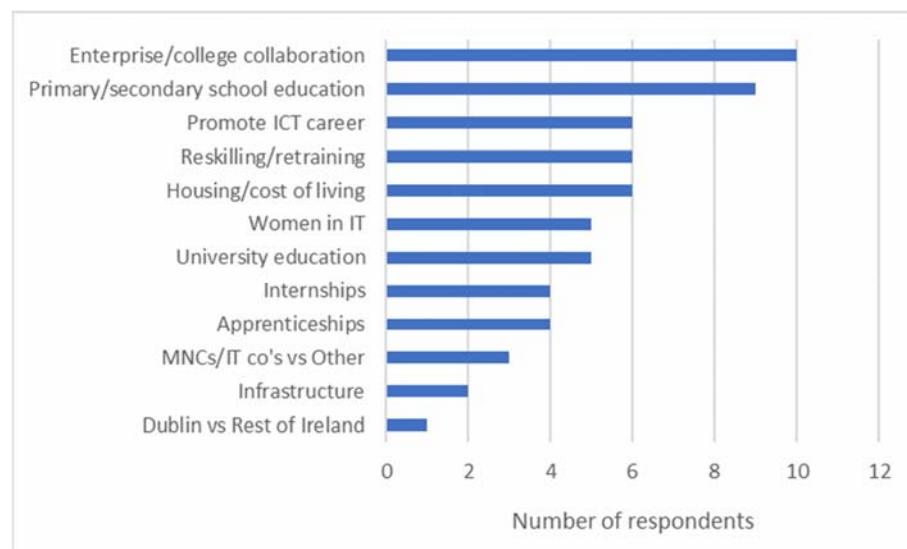
Source: IDC, 2018

The most suggested measure was for companies to work more closely with third-level education institutions to increase the pipeline of graduates coming through the system and to help ensure that they are being taught the things the industry needs.

> *"If a company is finding it difficult to hire then it must be doing something wrong. They need to build relationships with colleges. My division rarely hires a graduate that we don't know already from an internship or similar. Need to create a pipeline of talent. The challenge for the state education system is to avoid the danger of the calibre of student going into computer engineering falling below what is necessary."*
>
> *(Computing, Multinational)*

It should not be inferred from this that the engagement between the industry and these institutions is poor. Some enterprises have initiated links with the third-level sector in recent years and they are recommending that others follow suit. In most cases where such links have been set up the enterprise is seeing benefits already. For others these links were established many years ago and some enterprises depend heavily on these colleges and universities as a source of skills.

> *"Some years ago we had difficulties hiring grads and we set up a number of different initiatives, many of which are still running. We have a secondary*
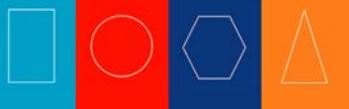
*school engagement programme for STEM which aims to enhance people's views of the industry and the company."*

*(Electronics, Multinational)*

Many respondents felt there is a need to make changes to primary and secondary education to create the conditions for an improved pipeline of students doing STEM subjects and entering ICT courses. Suggestions included the introduction of coding to primary schools.

*"Ireland needs to introduce a computer science curriculum in primary school and also needs to [encourage] females into STEM areas. Industry-leading companies need to come together to invest in these common skills that we all need." (Computing, Multinational)*

The need to promote ICT as a career was prominent among the suggestions and improving awareness among schoolchildren was seen as a component of this.

*"Promote ICT careers at secondary level — there is a fair bit of that being done already. The state needs to keep the emphasis on tech and the fact that the higher-paid jobs are in this sector. Keep that flag flying."*

*(Computing, Indigenous)*

A number of organisations emphasised the need for enterprises themselves to improve their reskilling/retaining efforts.

*"Our retraining strategy is the way forward and we will continue to do it. We cannot find everything we need in the marketplace so we favour a 'build' approach. We also offer flexibility and mobility among our staff so people can change roles and jobs. This adds a dimension to their career."*

*(Finance, Multinational)*

*"There is a need for companies to develop, in conjunction with the education system and professional associations, accessible and affordable retraining and continuous education for experienced, tenured ICT professionals without needing to re-enter full degree/masters courses to acquire qualifications in these new skills."*

*(Business Services, Indigenous)*

A number of organisations were very specific that there need to be further efforts to attract females into ICT careers.

*"The gender balance goal is a big one for us. Should we be aiming to get females who have left the ICT workforce back into it?"*

*(Computing, Multinational)*
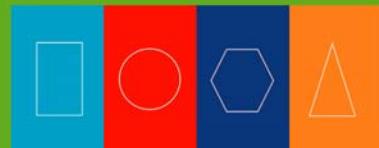
Finally, a few organisations mentioned internships as the way forward based on their own positive experiences. Taking students on internships gives a potential employer an opportunity to assess a student's capability and suitability for recruitment. It can also increase the level of connection a student has with a particular company.

> *"Our approach is to take interns into the company and then hire them. That has worked well thus far. In general, it is important to make your company attractive so you can compete with other companies [for skills]. The internship programme (in conjunction with a number of third-level institutions) has helped."*
>
> *(Computing, Indigenous)*
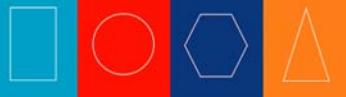
# Key Informant Interviews — Results and Analysis

The target list for the key informant interviews was drawn up by the Expert Group on Future Skills Needs Secretariat and included representatives of many stakeholder organisations. These included people with a range of qualifications and expertise from academic institutions, government agencies such as IDA Ireland and Enterprise Ireland, industry representative bodies and selected individuals who would have a view on the demand for ICT skills area across the industry as a whole or in one particular part of it.

A total of 20 interviews were conducted and much of the questioning was qualitative. While all respondents had views on demand for ICT skills generally, some are involved in, and are knowledgeable about, particular parts of the ICT sector and therefore many interviews were focused on this area of expertise.

## Main Issues Affecting Demand

In the early part of each interview we aimed to get respondents' views on what critical issues are affecting the demand for ICT skills in Ireland both within the ICT sector and in other sectors of the economy.

**Figure 20: Main Issues Affecting Demand**



n = 20
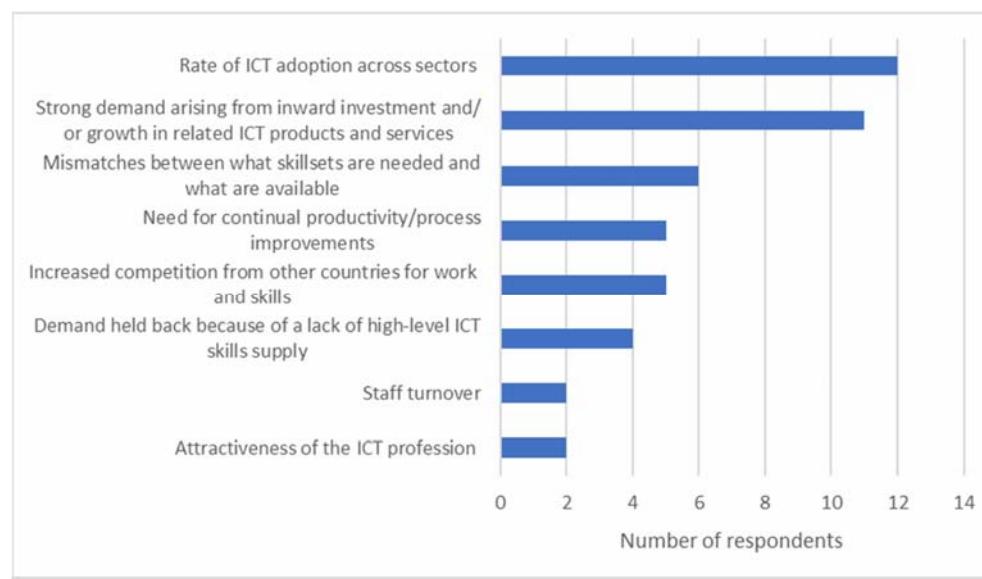
Source: IDC, 2018

The key issue according to most respondents was the increased pervasiveness of ICT across industries and not just within the ICT sector itself. This is, of course, a global phenomenon and not
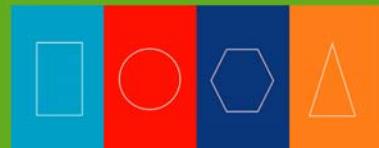
confined to Ireland. More specific to the Irish situation is the issue of demand arising from inward investment to Ireland by global multinational companies. This growth is continuing and shows little sign of easing up despite the pressure on the supply of ICT skills.

> *"The greater use of technology is driving demand in a range of industries including medical companies, construction and agri-tech. IT is now pervasive and this is driving demand."*

The term "digitalisation" was used by a number of respondents to describe the way that ICT is being adopted in non-ICT sectors to improve processes and productivity with the result that there is increasing demand from these sectors for ICT skills, at a time when they are already in too short a supply to meet the needs of the ICT sector itself.

> *"Demand in Ireland is driven by FDI and a big base of startups, a young population, digital transformation in organisations. In sectors other than ICT there is a growing digitalisation which will have a major impact on skills requirements in these sectors."*

> *"[Demand is being] driven by growth in the high-tech sector in general both indigenous and MNCs and also by small startup companies especially in the cloud and AI space. There is demand for skillsets that we haven't needed before in the industry. Many of the new jobs are because of advances in technology. AI, machine learning skills, for example."*

Much of the demand is for a variety of ICT skills in established areas such as software development where there is a global scarcity. In addition, the dynamics of supply and demand are being impacted by the newness of many of the skills that are most sought after, in areas such as artificial intelligence and machine learning. Not enough time has elapsed to allow graduates with these skills to come through the third-level education system in sufficient numbers. Another component of the problem is that the demand for ICT skills in Ireland is exacerbated by the fact that such a large number of ICT firms are located here.

Some parts of the industry have had demand increase enormously in a short time. The animation sector has seen demand for skills increase as new entrants to the market such as Netflix have seen the global market increase exponentially. The computer games market is also outpacing all other forms of entertainment.
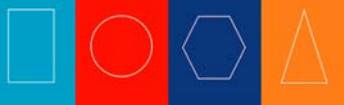
## Likely Trends in Next Five Years: Computing Skills

**Figure 21: Likely Trends in Next Five Years: Computing Skills**
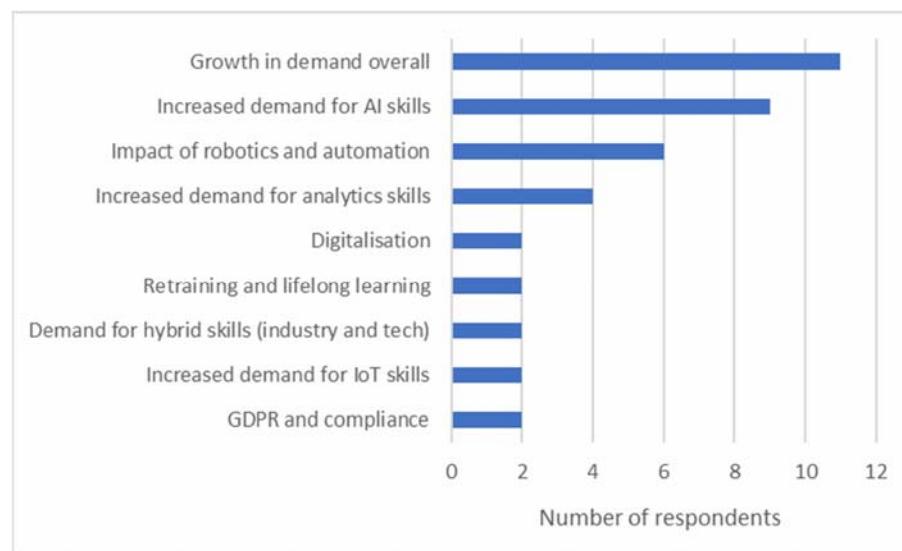


n = 20

Source: IDC, 2018

Despite the fact that ICT skills demand is very high at present no respondent expects this to ease in the next five years. All expectations are that demand will, in fact, increase. More specifically there will be increased demand for specific skills, particularly in artificial intelligence, robotics and automation and data analytics.

> *"There are 40%–50% more people employed in the overall technology sector between 2011 and 2017. If we continue in the same vein we could see growth of 10% per year. That would mean between 180,000 and 200,000 people in the broad technology sector in five years' time, an increase of around 50% on the current figure."*

The increase in demand will bring challenges.

> *"Not able to say what the figure will be but it will be very strong growth. And unless we can keep up with and prepare for that demand industry will go to countries that can provide that capability and skills. As part of the EU we in Ireland should make sure we are seen as a centre of excellence from a European perspective. We should be looking at how we can bring the skills in to be seen in this way."*

## Likely Trends in Next Five Years: Electronic and Electrical Engineering Skills

Figure 22: Likely Trends in Next Five Years: Electronic and Electrical Engineering Skills
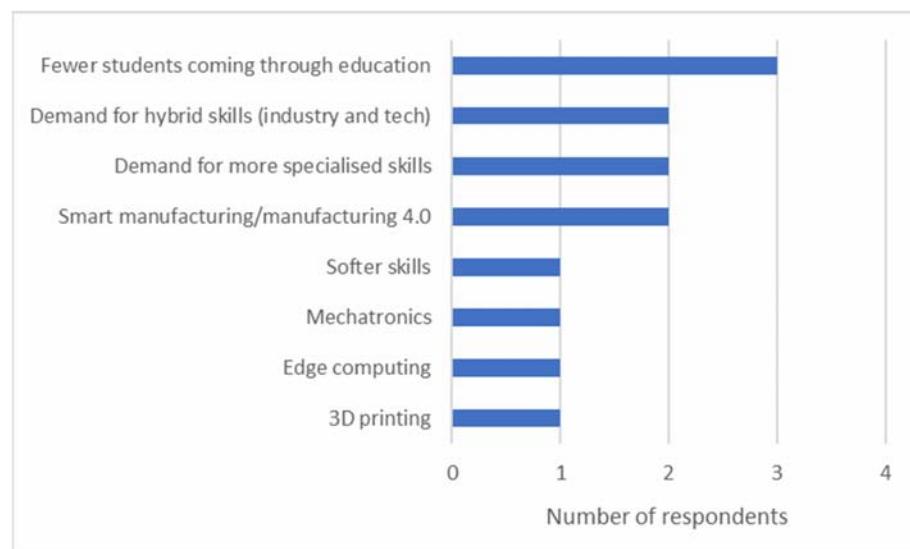


n = 20

Source: IDC, 2018

When we look at demand for electronic/electrical engineers we see that the dynamics are different to that of computer engineers. This sector of the ICT skills market is much smaller but so too is the supply of skills, so the challenges are similar and enterprises are finding it difficult to find people with the skills they need.

> " There will continue to be demand [for electronic/electrical engineers] but there will be fewer students doing these courses. Companies demand a more specialised skillset so it is becoming a more niche career. There is less supply for this reason."

The following comment provides more detail on the decline in graduate numbers.

> "The electronic/electrical engineering career has become less attractive as software engineering became the thing people wanted to do, or business courses, for example. Nowadays there is a shortage of people going into electronic/electrical as students choose other engineering streams ahead of it, such as mechanical or pharma. Perhaps the industry hasn't done a good job at promotion but the course itself is more difficult to follow."

As described above, the key trend in the next five years will be the scarcity of students graduating in this discipline. Other trends identified in the research are the changing skill requirements in this

area. Hybrid skills will be required, a mix of electronics and IT. There will also be demand for more specialist skills.

> *"Mechatronics is becoming more important. It combines civil, electrical and mechanical engineering. There is pressure for engineering not to forget the fundamentals. Colleges are being criticised for being too specialist. Electronics courses are becoming more rounded with a requirement to focus on softer skills like teamwork and the ability to communicate."*

## Relative Demand for ICT Skills Levels in Next Two to Five Years

**Figure 23: Relative Demand for ICT Skills Levels in Next Two to Five Years**
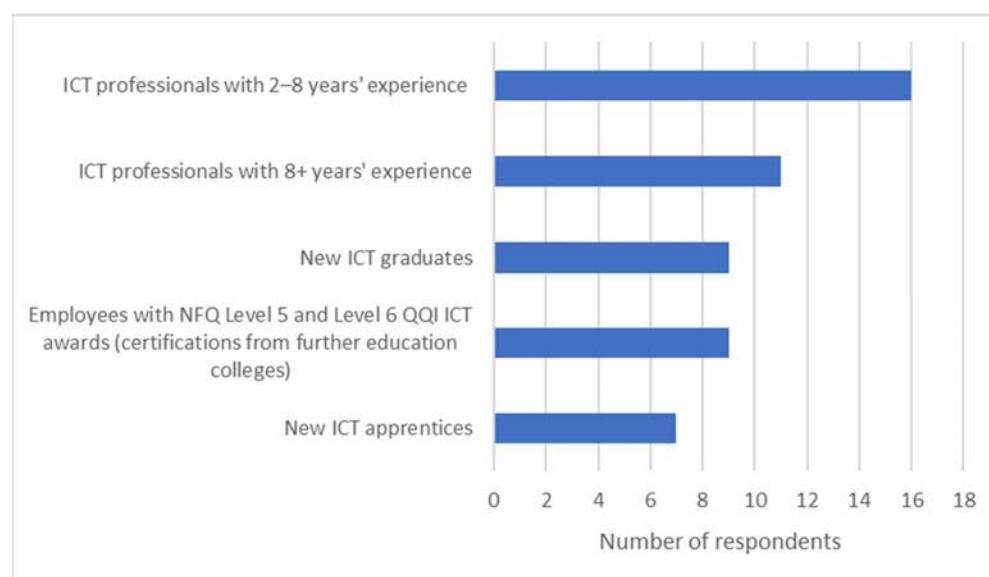


n = 20

Source: IDC, 2018

Respondents were further questioned about the relative demand for different levels of ICT skills in the next two to five years. Most respondents expect that demand will be strong at all levels. However, the majority consider the greatest demand will be for personnel with two to eight years' experience followed by those with more than eight years.

> *"The main demand will be for mid-level people, that is, with a few years' experience. So people with three to eight years are the hardest to find."*

However, demand for new graduates will also be strong particularly in the newer technologies.
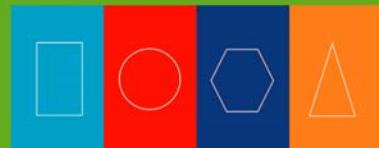
*"Particularly strong demand for graduate engineers and those with three to five years' experience. Recent grads are in demand to cover the more recent technologies."*

There was less knowledge among respondents about the likely level of demand for people with lower- level qualifications such as NFQ Level 5 and QQI Level 6.

*"This area will have lower demand than average. Level 8 will be the sweet spot, followed by Level 9, then Level 6/7 and then Level 5."*

It was considered that there would be little demand for these lower-level qualifications in the electronics/electrical engineering sector.

*"I don't see demand at Levels 5/6. This is a very-high-tech industry. Levels 8/9/10 with four to five years' experience will see the biggest demand."*

However, a number of respondents saw considerable potential for people with these levels of skills.

*"Regarding L5, L6 and ICT apprenticeships — if more quality candidates are produced in this area with skills then companies will hire them. Companies were reluctant to get involved at the beginning because they would be the trailblazers but now they are competing to get more of the grads out of these programmes as they see what is available."*

*"I believe the L5/6 dual education can help meet the needs of companies looking for three to four years' experience."*

## Meeting the Demand for High-Level ICT Skills

Much of the remainder of the discussions with respondents sought to find solutions to address the high level of demand for ICT skills in Ireland in the coming years.

One part of the questioning focused on the relative challenges faced by different types of organisations — global multinationals, indigenous ICT companies, ICT enterprises — serving the local market and organisations in a range of non-ICT industries that, nonetheless, employ people with ICT skills to support their organisations.

*"None of these are meeting their requirements. In some way their needs are similar. All are lacking people. The IDA companies get the cream of the crop as they can pay most, also the big indigenous firms like the banks, etc. The smaller companies can't and they have more requirements in one person. This results in slower growth of the companies."*

The majority view was that the global multinationals are at an advantage in the competition for ICT skills particularly, but not only, at graduate level. They have the big brand names, they can offer higher salaries and a range of other benefits. Some respondents, however, consider that the
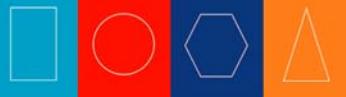
"attractiveness" gap between these global multinationals and the indigenous Irish firms has reduced in recent years. Even the smaller firms have for example made efforts to ensure their offices/working environments are more attractive.

There is a still strong sense that competition from the multinational sector for ICT skills can have a big effect on smaller indigenous firms. The impact of losing even one or two people from a team can be large. Retention of staff is difficult and there is considerable evidence that salary levels are growing as a consequence.

> *"There are a couple of effects [on Irish indigenous ICT enterprises]. Firstly, costs are rising because of the salary situation. In some cases, their product rollouts are impacted. In short it is affecting their growth."*

A respondent involved in HR at a major global multinational commented on the situation at its Irish operation.

> *"[Our company] is succeeding in getting the people it needs in the timeframe it needs. Sometimes we have to adjust what they need and look at internal training programmes but in general we are finding the people. We are bringing in people from abroad for things like AI and machine learning but that is a good thing. Our message to corporate HQ is that we can meet demand within Europe. As long as Ireland continues to be an attractive place for Europeans to come and work there won't be a problem."*

However, the challenge to the overall industry remains.

> *"The number one issue for all ICT companies is skills availability (IDA and EI). They would all say their demands are not being met. The organisations that are users of technology are likely to be finding it difficult too. Growth is happening but there is a gap between what is required ideally and what is being achieved."*

## Macroeconomic Trends

In order to put the ICT skills demand challenge into context all respondents were asked to comment on the current economic and political environment and how it might affect demand.

The majority of respondents consider that the current environment is very positive for the ICT industry and, consequently, for ICT skills demand.

> *"The economic outlook for the ICT sector is very strong. Political support for that sector globally is also very strong and contributing to demand. Whether it is an opportunity or a challenge is dependent on which sector you are in. If you are running a non-ICT business then you're negatively*
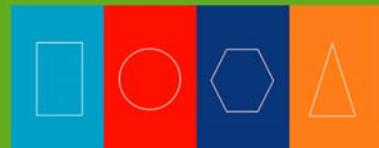
*impacted by rising costs of ICT people. But if you're delivering ICT services the outlook is good."*

However, some challenges exist already, while others may appear in the near future.

*"Issues around [income] tax rates are relevant here. Politically the environment here is very positive. Housing is an issue but broadband not so much now. We just need to get more people to work in the industry."*

*"The biggest problem in Ireland is infrastructure related — housing, schools availability, rental prices, etc. Schools availability for immigrants with families is a challenge. Public transport is inadequate."*

Clearly Brexit is an issue causing uncertainty.

*"Brexit uncertainty is another factor and it is hard to say whether it is more of a positive or negative. For the multinationals it may be a positive thing but for the indigenous a negative."*

When respondents were asked what economic factors will affect the evolution of ICT demand in the next five years Brexit again loomed large. The balance of opinion was that it could be a positive thing for the ICT sector.

*"Brexit can be a plus for Ireland with even more demand from businesses to come here. Financial services firms and software houses from the UK will come. There is also the possibility that companies concerned about privacy may come here because of our EU GDPR legislation."*

*"Brexit could be an advantage but there could also be disadvantages. The health of the global economy is important as it impacts the investment in digital transformation. Infrastructure will have an impact, too, smart cities, autonomous vehicles."*

Overall there was quite a bit of positivity about the likely impact of the economic and political environment in the coming years on ICT skills demand, and there was a reminder about the past 10 years.

*"In the midst of the major recession in Ireland the tech industry continued to grow in terms of jobs and demand for skills. If the economy weakens the tech sector can weather that better than other sectors."*

## Policies and Practices Influencing High-Level ICT Skills Market

In this section the policies and practices that exist and that impact the ICT skills market, some positively, some negatively, are examined.
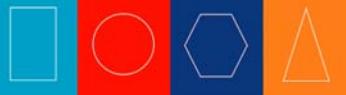
**Figure 24: Issues Affecting the High-Level ICT Skills Market**
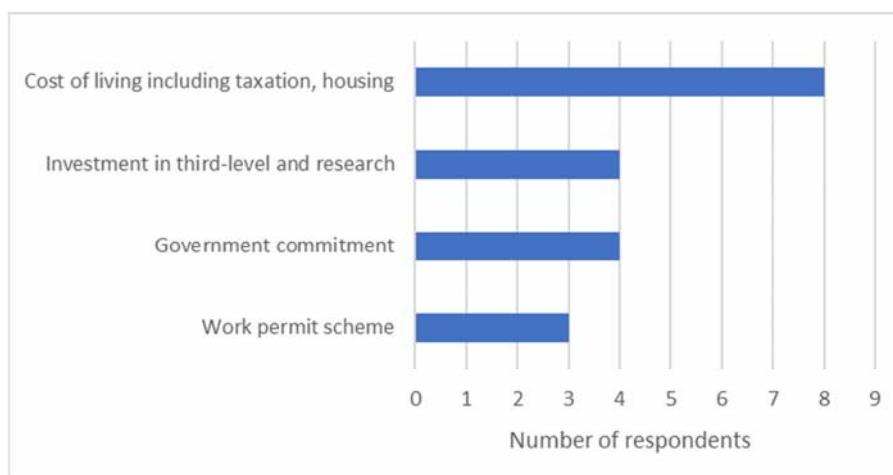


n = 20

Source: IDC, 2018

Figure 24 shows which policies and practices were considered most important by respondents. The positive ones will be focused on first.

A number of respondents alluded to the fact that the Irish government is very clearly committed in a positive way to the ICT sector. This is demonstrated in its focus on foreign direct investment (FDI) and in its support for indigenous ICT enterprises through Enterprise Ireland. Linked to this is the work permit scheme introduced to give Irish-based enterprises greater access to skilled workers from outside the EU to come and work in Ireland. This was a very clear commitment to the sector.

It is clear from the research that the easing of access to work permits as part of the ICT Skills Action Plan 2014-2018 has played a major part in facilitating further growth in the sector and, as a direct result, growth in the broader economy.

> *"On the FDI side we are doing a great job. The tax policy, work permits are working."*

> *"The STEM initiative is positive. ICT Skills Action Plan too. Huge amount of positive energy."*

On the negative side there is concern about the rising cost of living as a result of a lack of housing, which is driving up purchase and rental costs. Related to this is pressure on schools from a growing population and other infrastructure such as public transport, particularly in Dublin. In tandem with this is the issue of high levels of personal income taxation which can act as a disincentive for foreign workers considering coming here.
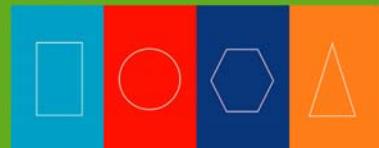
*"Wider economic factors are influencing it. Housing, infrastructure are becoming a bigger issue for employers. Taxation is also a grave concern where middle- income earners are hit harder than in other countries."*

The other major issue cited by respondents was a lack of investment in ICT research specifically and in the third-level education sector in general. This sector saw a fall in funding during the recession years and this has not been restored.

*"We spend 0.5% of GDP on R&D and that just isn't good enough. Other countries spend more."*

## Policies and Practices Needed to Address ICT Skills Demand

In the final part of the interview, respondents were asked to identify any policies and practices that should be undertaken in the near future to address the issue of ICT skills demand.

**Figure 25: Policies and Practices Needed to Address ICT Skills Demand**



n = 20
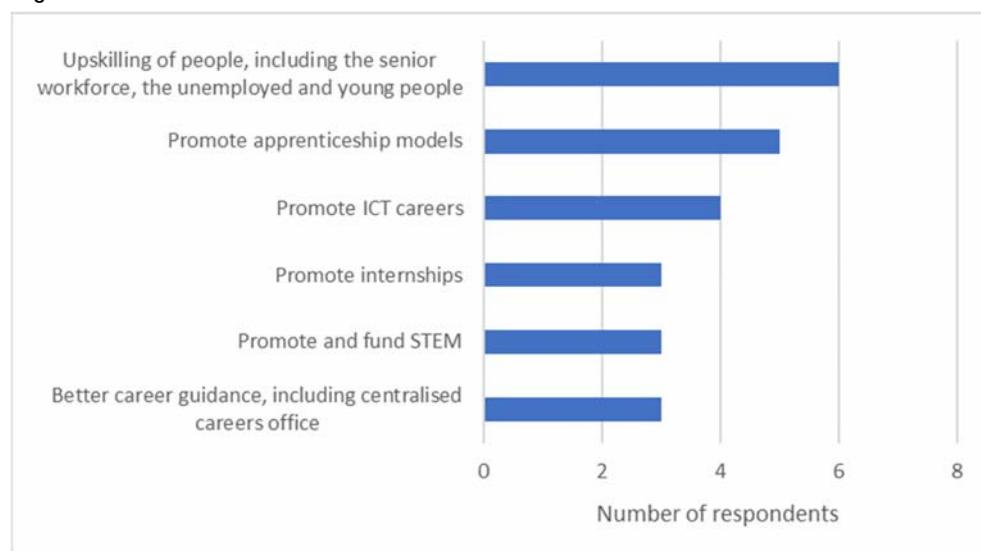
Source: IDC, 2018

The thing that was identified by most respondents was the need to upskill people. Many variations of this were suggested, including the retraining of older people and the long-term unemployed, attracting people (particularly females) back into the labour force and continuing to provide conversion courses. Another component of this is to involve academia in the retraining of existing ICT workers.

*"Industry needs to be encouraged to engage with academic institutions to undertake retraining for existing workers.*
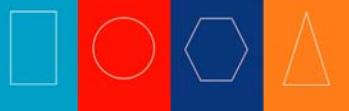
*"We have a huge untapped market of females who have been out of the workplace for a number of years. They need to be attracted back."*

*"We need to ensure that the capacity to deliver people with the required skills, not forgetting Level 5 and 6 as well. There will also be a major requirement for people working in many industries to be reskilled, upskilled."*

The promotion of the apprenticeship model was suggested by a number of respondents. This is already underway as part of a government initiative. It was considered that these apprentices will have a considerable impact in certain parts of the sector, in particular the public sector but more widely too.

*"Another route into the sector via apprenticeships needs to be taken very seriously. Government policy is now driving the apprenticeship model."*

Internships as a form of apprenticeship were also mentioned as something that should be promoted in academic institutions.

*"I want to see more in-company placements as part of an improved partnership between academia and industry."*

A number of respondents suggested that ICT as a career needs to be promoted further. It was recognised that measures are being taken already in this regard. Linked to this was the promotion of STEM subjects in the school system. Again, while work on this is underway already it was felt by some that more needs to be done.

*"Education policy needs to move up a gear. We need flexibility and agility in our primary and secondary schools around the STEM subjects and the qualifications our teachers have and to upskill them to be up-to-date on these things so they can educate our children appropriately. In addition, our career guidance teachers need to be aware of the dynamics of the workforce of the future. It is critical to get children and parents informed about the future."*

Reference was made to career guidance by a number of respondents. It was suggested that if the government is to be successful in its efforts to promote STEM subjects and ICT as a career, improvements need to be made in how career guidance is done in Ireland.

*" A major issue is career guidance in this area, which I believe is highly ineffective. We need a central portal focused on engineering careers. What kids do now is interact with good content (video, social) and the teacher is not needed. They just need to be able to ask questions. A centralised office for careers, particularly in key areas, is what is needed. Much more impactful."*
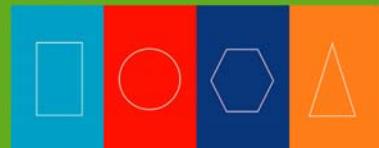
*"Career guidance teachers need to be upskilled and attitudes changed. They need to be educated about the new career paths that children could be taking."*

Overall, there was a sense that much is being done to improve the supply of ICT skills and a recognition that many of the measures taken have worked well. The focus was on improving existing initiatives and removing some things that were impeding success.

## SWOT Analysis of Ireland

A SWOT analysis was included as a component of the interviews with key informants. There was a good level of agreement among respondents on the key elements.

**Figure 26: A SWOT Analysis of Ireland**
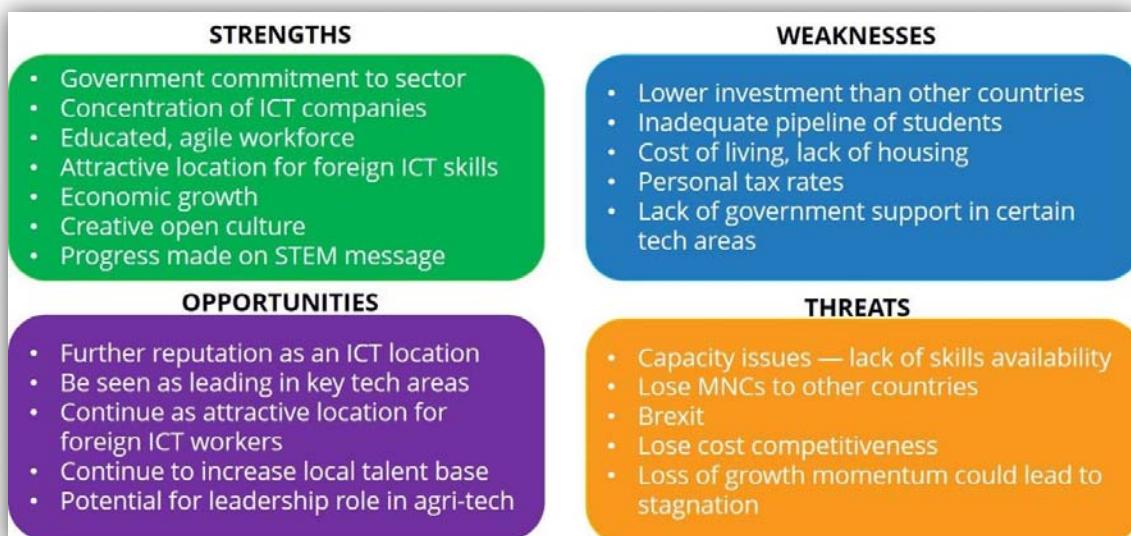


n = 20
Source: IDC, 2018

**Strengths**

Largely as a result of strategic policy decisions made by successive Irish governments, implemented by government agencies, Ireland has developed a strong ICT "industry" with most of the major global names having a presence. The low corporate tax rate is the key supportive policy measure but by no means the only one.

Ireland has a high-quality, educated workforce with a good reputation for creativity and problem-solving. Good industrial relations are the norm in the sector. It has been very successful in attracting people from abroad with ICT skills to come to Ireland to work and live. The country is acknowledged as having a creative, open culture and its recovery from the economic and financial difficulties in recent years has presented a very positive image to the world.
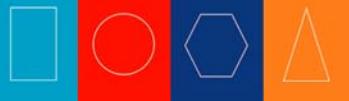
## Weaknesses

On the negative side, there are some areas where Ireland does not invest as much as other countries with which it competes as an ICT location. Respondents cited lower spending on R&D in the ICT area, while investment in third-level education has not recovered from the budget cuts enforced by the financial crisis.

Though major progress has been made on improving the supply of graduates in STEM disciplines there are still not enough coming through the Irish education system. As a result, the sector depends heavily on foreign workers coming to the country. This is happening at a time when a lack of housing and associated infrastructure is causing rents to rise and the cost of living to increase. The country's ability to attract immigrant workers is not helped by high rates of personal tax.

Furthermore, in some high-potential areas of the ICT industry, notably gaming and animation, there is a perceived lack of government support.

## Opportunities

A key opportunity for Ireland is to further its already excellent reputation as a location for ICT companies. It can play a leadership role in the ICT revolution that is underway and is set to continue. The country has the potential to be seen as a leader in certain parts of the ICT industry, though it should not try to be a leader in all parts.

The country is already seen by people with ICT skills around the world as a good place to come and work. This can continue to be the case if the infrastructural barriers are addressed. By continuing to attract foreign workers as well as promoting ICT as a career to Irish students the country can be the location that addresses the global ICT skills deficit better than others.

Finally, on account of Ireland's farming association it has the potential to be a global leader in the agri-tech area, particularly with respect to the dairy industry.

## Threats

The government continues to address infrastructural issues such as housing availability and roads. The key threat as identified by respondents would be if this effort failed to fix these problems. This could have a number of detrimental impacts. It would make it more difficult to attract the foreign workers that are needed and this may lead to ICT firms taking the decision to close their Irish operation. Brexit is another possible threat but there is still no certainty about what impact it will have.

Finally, respondents identified the importance of momentum to the ICT industry in Ireland, particularly among the FDI firms. These companies' Irish operations need to continue to grow in order to justify their existence in the global ecosystem. While this is unlikely to lead to an extremely negative outcome, the fact that the sector continues to grow is very important.
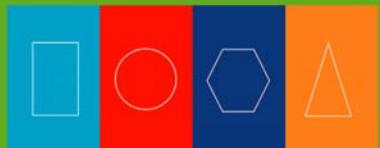
## Input and Deliberations from the Workshops

The consultation with stakeholders culminated in two workshops titled "Forecasting the Demand for High-Level ICT Skills in Ireland", organised by the Expert Group on Future Skills Needs Secretariat and IDC in Cork (January 16, 2018) and Dublin (January 17, 2018), with participants from leading ICT industries, research and policy making. IDC presented the highlights of the study and the draft skills demand scenarios, while a representative from the Department of Education and Skills presented an overview of the forthcoming ICT Skills Action Plan.

Each workshop included two main discussion sessions. The first one focused on the main drivers shaping demand for ICT skills in Ireland under three alternative scenarios up to 2022; the second session discussed the main actions that need to be taken to satisfy ICT skills demand and improve Ireland's competitiveness and growth. The results of the workshops were used to finalise the scenarios and their storylines (as presented in the chapter 4) and contributed to the identification of the most relevant policy actions in the stakeholders' opinions (presented in chapter 5).

The feedback on the scenarios confirmed the status of the baseline scenario, "Keep Running to Win", as most likely and realistic. Workshop participants considered the two alternative scenarios — "Dancing with the Stars" (High Growth scenario) and "Shaken by Cold Winds" (low growth scenario) — as less likely but possible, providing new ideas about the main factors shaping them.

The most relevant insights from the workshops were the following:

- Consensus on the combination of global trends of technology innovation and rate of ICT innovation adoption as the most relevant factors driving the demand for ICT skills in the period to 2022. This was coupled with a certain optimism about current positive growth trends of the Irish economy and the Irish ICT market continuing in the coming years.

- Concern about the increasing mismatch between skillsets available and those needed, requiring proactive policy and industry actions to stimulate the development of new emerging skills (driven by new technologies, such as data analytics, artificial intelligence and cybersecurity) but also of soft skills, such as teamwork and problem-solving capabilities.

- On Brexit there was great uncertainty. Largely, this was due to the notion that the real impact will be most likely to occur at the end of the considered period — perhaps even later. Expectations are that there will be various impacts differing by sector with the effect on the ICT industry being positive rather than negative, as there could be an opportunity to attract businesses and for talent to relocate to Ireland. The majority considered a "soft Brexit" scenario more likely than a "hard Brexit".

- Concerning the factors that might push the Irish ICT market onto a faster growth path, the participants pointed to an improvement of the Irish ICT industry's competitiveness (more

startups, Irish multinationals moving higher up the value chain) and the potential opportunity for Ireland to become a leading hub for cloud-based data platforms in Europe.

- Given current positive trends, stakeholders agreed that the main threats to growth could come from external factors: a hard Brexit, a global slowdown of economic growth, increased competitiveness for talent or in the attraction of multinationals by other countries, in Eastern Europe or elsewhere.

- Finally, the participants recommended several actions to be taken by policymakers, industry and the education sector in collaboration or separately (see the list in Figure 27 below) but mostly underlined a feeling of urgency and the need to identify and implement measures with short- term impacts. The stakeholders broadly approved the ICT Skills Action Plan strategy and appreciated some of the measures taken in recent years (to attract talent from abroad, for example) but felt that most of the actions were expected to have an impact only in the medium to long term. The housing shortages and inadequate public transportation emerged strongly as problems requiring prompt action, as they reduce Ireland's attractiveness to talent.

**Figure 27: Actions Recommended by Workshop Participants**
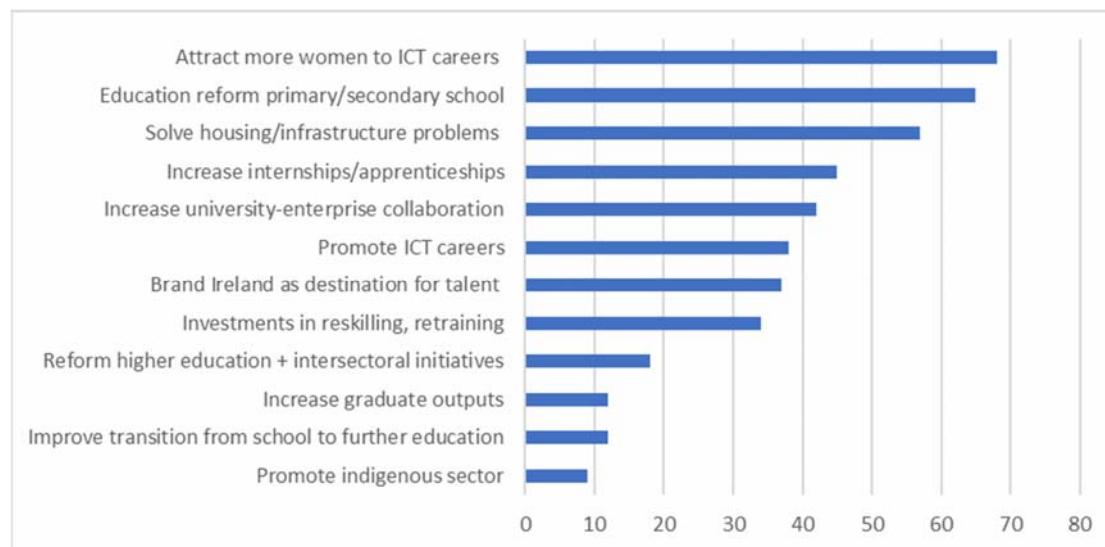


Source: IDC, 2018
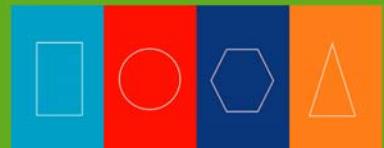
# Chapter 3- Assessing the Demand for High-Level ICT Skills

Assessing the demand for high-level ICT skills in Ireland is complex because of the unique combination of its status as a small open economy with a strong export focus, where a large proportion of the skills needed are not just serving demand created in the domestic market. Demand is also strongly dependent on market conditions and patterns in the global ICT market, as well as the relative competitive proposition for FDI and availability of skills from other countries and regions around the world.

In order to make this assessment, IDC used its proprietary ICT skills demand model to create the forecast presented in this study. For more than a decade, this model has been used on behalf of the European Commission to forecast the demand for ICT practitioner skills in Europe. For this study, the demand model is adapted to reflect the conditions specific to Ireland.

The standard model has been developed to be able to support demand forecasts across a wide set of countries. Hence it:

- Uses, as input, statistical information from reputable sources (typically country statistical offices or Eurostat)
- Takes into account local economic developments based on historical and — where available— official forecasts
- Takes into account IDC's forecasts and predictions for ICT technology and services spending in the country examined; these forecasts are developed by IDC's domain expert analysts
- Forms part of a holistic view of the ICT technology and workforce markets to ensure that there is no "sub-optimisation"

However, for Ireland, specific adaptations have been made to capture the complexity of both the broad Irish ICT sector and domestic demand. These include:

- Expanding the view to include R&D and other "ICT production" outside IDC's traditional view of ICT spending
- Customising and establishing the baseline data utilising existing available data
- Looking at ICT exports as well as local "consumption" to ensure that the impact of global ICT market demand is captured
- Utilising input and information gathered through the research process from the key informant and enterprise interviews, workshops and relevant stakeholders in general

Figure 28 provides an overview of the model in terms of the data inputs for the baseline and how the forecasting process feeds the development of different skills demand scenarios.
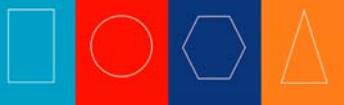
**Figure 28: Schematic View of Scenario Building and ICT Skills Demand Forecast**
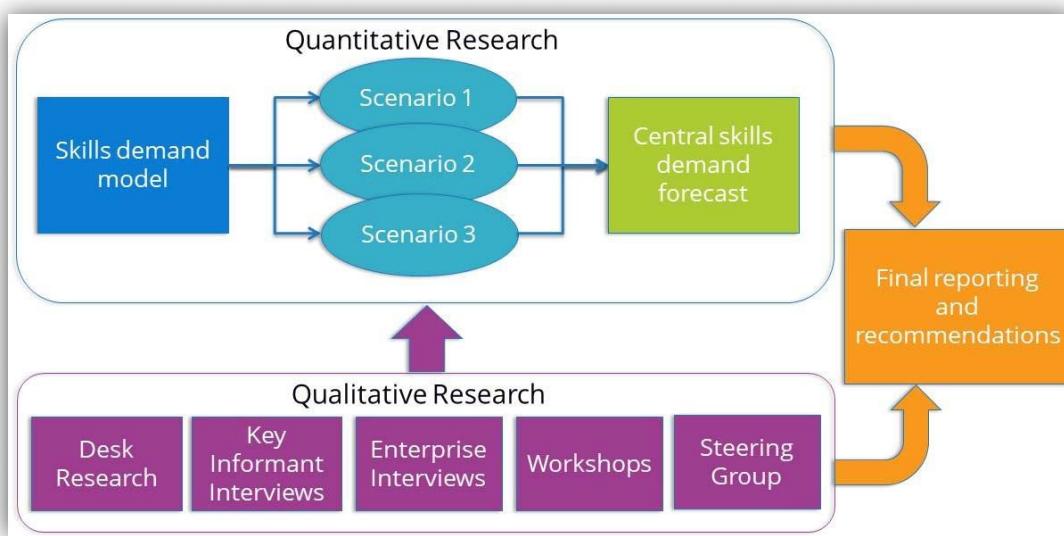


Source: IDC, 2018

Throughout the project, there was a continuous loop of adjustments to the key variables as data gathering, key informant feedback, etc. was evaluated and used to inform the forecasting, and to establish the final scenarios.

## Key Assumptions

As described earlier, the main objective of the model was to assess the demand over the period 2017-2022 for high-level ICT skills (specifically for computing skills, electronic and electrical engineers, and those with a combination of high-level ICT and business/analytic/foreign language skills) across the whole economy. The baseline year was 2016 as it is the year with the latest available employment statistics. In order to assess demand over the forecast period and to reflect the holistic market for high-level ICT skills in Ireland, it was necessary to make some specific assumptions. These are presented in summary format below:

▪ Segmenting the broad ICT sector from other sectors. To decide the weighting of the broad ICT sector versus other sectors, the employment statistics from the CSO Census for 2016 (Standard Occupational Code/SOC 2010) were used. The following assumptions on the breakdown of ICT professionals (computing and electronic and electrical engineers) employed outside the broadly defined ICT sector were applied in line with the 2013 project:

- 50% of ICT professionals employed in the manufacturing industry are employed in ICT manufacturing (e.g. Intel) and therefore part of the broad ICT sector. The remaining 50% are counted as ICT professionals in "Other Sectors".

- It is assumed that 75% of ICT professionals working in the financial services sector can be considered part of the broad ICT sector. The remaining 25% are counted as ICT professionals in Other Sectors.
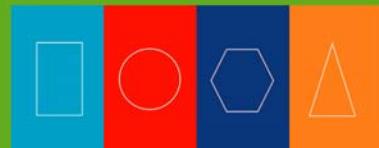
- In the professional, scientific and technical activities sector, it is assumed that 75% of ICT professionals working in this sector can be considered part of the broad ICT sector. The remaining 25% are counted as ICT professionals in Other Sectors.

- Of the segment "No industry stated", it is assumed that 75% of ICT professionals working in this sector can be considered part of the broad ICT sector. The remaining 25% are counted as ICT professionals in Other Sectors.

- Of the broad ICT sector, 10% can be assumed to serve Irish user organisations.

- In 2016, there were 81,595 ICT professionals employed in Ireland. The assumptions above result in a segmentation of 55,866 ICT employees in the broad ICT sector (68% of the total) and 25,729 (32% of the total) in Other Sectors.

- Since 10% of the broad ICT sector can be assumed to serve Irish user organisations rather than the export market, this means that about 42% of ICT employment in 2016 was for serving Irish domestic demand and 58% for serving ICT export markets.

- In the forecasting of the broad ICT sector versus Other Sectors, the increased digitisation of Other Sectors has been factored in.

▪ Establishing the total demand for the 2016 base year.

- While there were 81,595 ICT professionals employed in 2016, this is not the total demand. At any point in time, there will be a number of unfilled vacancies that need to be added to the employment figures to arrive at the total demand. As stated by Eurostat: "Job vacancy statistics provide information on unmet labour demand." Data from the enterprise survey conducted as part of this study indicates there are 5.2% unfilled vacancies for computing skills and 6.9% for electronic and electrical engineering. Since no other data is available, it has been assumed that there was a similar picture in 2016. This leads to a total demand in the 2016 base year of 85,515.

▪ Segmenting computing and electronic and electrical engineering.  Using the same statistics as above of SOC 2010 by sector, the following assumptions are used (codes denote the different occupations):

Computing skills are:

- Information technology and telecommunications directors — Code 1136

- IT specialist managers — Code 2133

- IT project and programme managers — Code 2134

- IT business analysts, architects and systems designers — Code 2135

- Programmers and software development professionals — Code 2136

- Web design and development professionals — Code 2137

- Information technology and telecommunications professionals not elsewhere included — Code 2139

- IT operations technicians — Code 3131

- IT user support technicians — Code 3132

- IT engineers — Code 5245
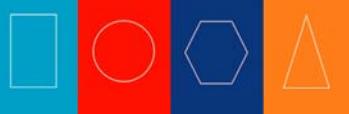
Electronic and electrical engineering are:

- Electrical and electronic engineers — Codes 2123 and 2124

- Design and development engineers — Code 2126

- Electrical and electronics technicians — Code 3112

- Telecommunications engineers — Code 5242

▪ Segmenting high-level ICT skills by NFQ Level: This split is based on SOC 2010 data with high-level ICT skills being split by NFQ levels 6/7 and 8+. NFQ Levels 8+ have seen a higher CAGR (9%) over the 2011-2016 period than Levels 6/7, which has been built into the model.

▪ Estimating potential job openings: When we look at the total number of potential job openings arising in a specific year, this includes both net new jobs that have to be filled due to expansion demand and existing jobs that have to be filled due to replacement demand, including due to retirements, job switching to non-ICT professional occupations, unemployment, move to inactivity, emigration or other reasons.

The following assumptions have been made in relation to the calculation of the total number of potential job openings:

▪ Expansion demand is calculated as the net new number of jobs between two years.

▪ Replacement demand is calculated using the following assumptions:

- Levels 8+: assume that 4.5% of existing high-level ICT staff would need to be replaced each year. This is line with 2016 estimates by the UK Commission for Employment and Skills.

- Levels 6/7: apply a lower rate (since NFQ Levels 8+ would be more portable in a strong global market for such skills, including Europe). A rate of 4% has been used for NFQ Levels 6/7, for both computing and electronic/electrical engineering.

- Contributory reasons for replacements include: Retirement; Job switchers to other non-ICT professional occupations; Unemployment; Looking after the family; Becoming a full-time student; Other inactive reasons; Emigration

▪ Forecasting the most likely demand growth for the baseline scenario.

- Demand growth in the broad ICT sector is based on the following assumption: Agency-assisted employment continues to outgrow other sectors including the non-assisted indigenous Irish sector.

- Demand growth in Other Sectors: Slower technology adoption and hence growth in demand for ICT skills in Irish companies outside the broad ICT sector.

The baseline demand for ICT skills was established under the assumptions above. The process was guided by official statistics and data from, for example, the Central Statistics Office, IDA Ireland, Enterprise Ireland and the Department of Business, Enterprise and Innovation, as well as relevant input from the interview process. The expected demand growth was developed under three forecast scenarios, as presented in chapter four.
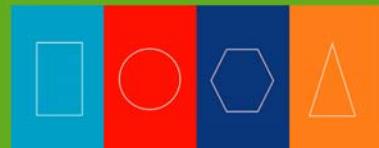
The model has proved highly accurate. The model and the methodology described above resulted in the demand data presented in the study Addressing the Future Demand for High-Level ICT Skills in Ireland, published in November 2013. In that study, the central growth scenario estimated a demand for 80,790 in 2016. The CSO Census Business Demography data released in June 2017 indicated actual employment of 81,600 — 1% higher than the estimate produced by the model.

In addition, the central scenario presented in the above referenced study resulted in a CAGR of nearly 5% between 2013 and 2018. This is in line with the findings reported in the National Skills Bulletin 2017 on statistics on IT occupations, which states that that "between 2011 and 2016, total employment in IT operations expanded by 5% on average annually"[17].

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17 Skills and Labour Market Research Unit, SOLAS, "National Skills Bulletin", 2017, p.95
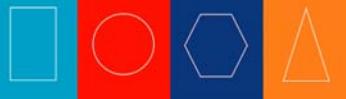
# Chapter 4- ICT Skills Demand Scenarios, 2018–2022

This chapter analyses the main drivers and barriers to the development of ICT skills demand in Ireland and projects them to 2022 under three alternative development paths: a central scenario based on most likely trends, contrasted by a more positive accelerated growth path versus a more negative, slower growth path. Scenarios are not predictions but images of the future, exploring the potential consequences of different market trajectories and therefore providing a guide to action by helping to think through the potential actions that may help to maximise the chances of positive impacts and counteract negative impacts.

In this study, scenarios were developed in parallel with the forecast model of ICT skills demand to help shape the growth trends and explain the rationale behind demand projections. Scenarios and the quantitative model are developed together so that feedback loops guarantee coherence and increase the solidity and reliability of forecasts.

**Figure 29: Scenario Development and Factors**
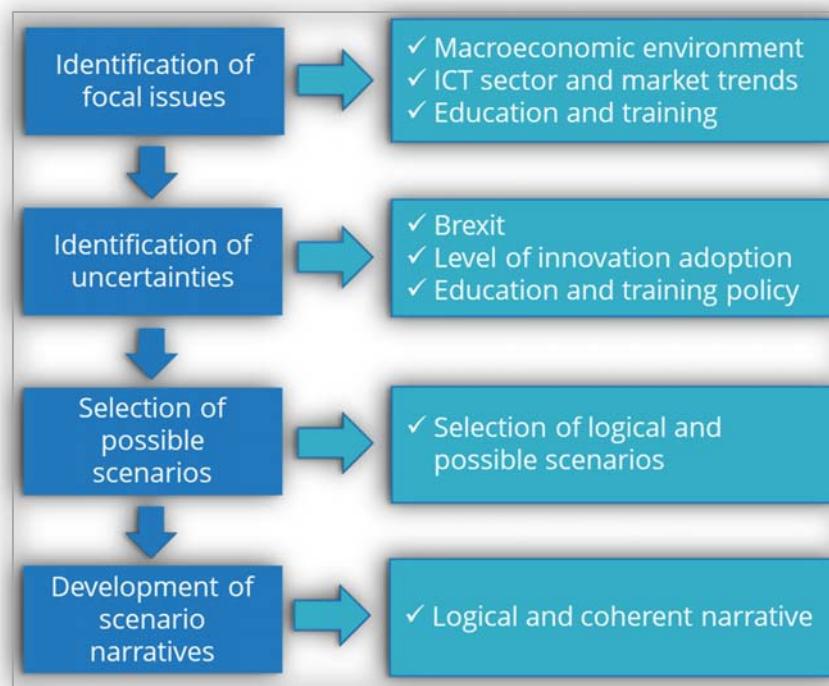


Source: IDC, 2018

The methodology is based on well-recognised methods of scenario development that have been adapted to the forecasting of ICT markets and includes the following steps, summarised in Figure 29 above:
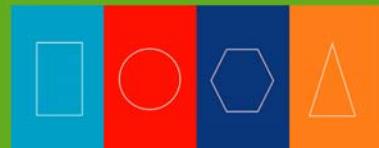
- Identify focal issues affecting the scope and timeframe of scenarios. For the sake of this study four main groups of factors shaping the demand for ICT skills are identified— macroeconomic factors, policy and regulatory factors, ICT market factors and global macrotrend factors.

- List key factors by area and rank them by level of impact on the targeted market and uncertainty. The high-impact, low-uncertainty factors will be the common elements (assumptions) of each scenario; the high-impact, high-uncertainty factors will be the differentiating factors of the scenarios. This is the critical phase in scenario building.

- Select scenario logics. In other words, sketch out scenario storylines by combining the main driving factors and assumptions on how they will evolve, eliminating contradictory or unlikely combinations.

- Develop scenario narratives in more detail. Check for coherence and consistency and work out the impacts of the scenarios.

- Present the draft scenarios to the stakeholders. Collect feedback to complete their development, assess their global likelihood and credibility, fine tune main factors, validate main impacts and make sure no relevant impacts are overlooked.

- Finalise the scenarios.

It is good practice in scenario development to involve a large group of stakeholders to provide a wide set of views and opinions. In this study the enterprise and key informant interviews shaped the identification of focal issues and key drivers, while the stakeholder workshops provided feedback and validation on draft scenarios and their consequences.
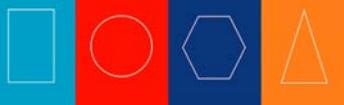
## Main Factors Shaping Demand for ICT Skills

The key factors shaping the evolution of demand for ICT skills can be grouped into four main areas, as shown in Figure 30 below.

**Figure 30: Factors Shaping the Evolution of ICT Skills Demand**
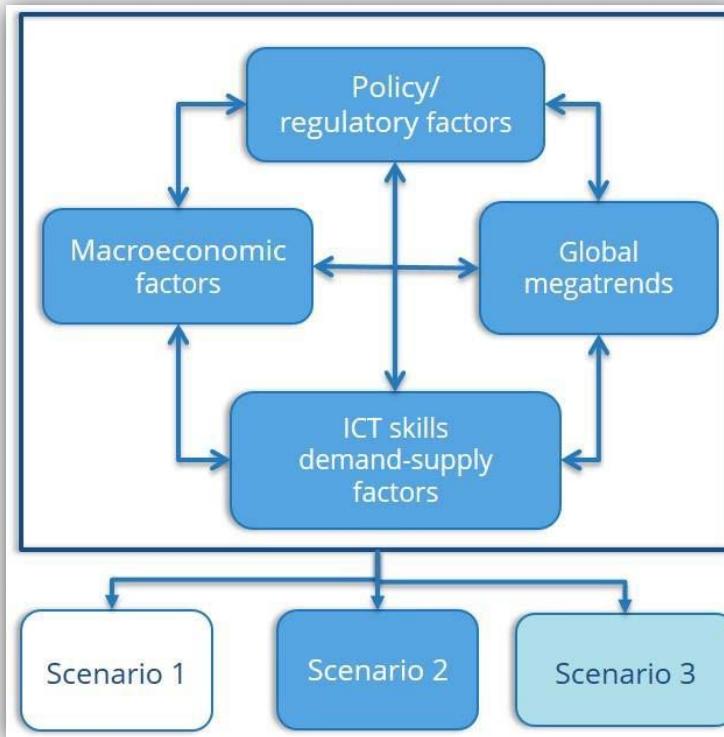


Source: IDC, 2018

### Macroeconomic Factors

Macroeconomic dynamics in this study are considered as largely exogenous to the ICT skills scenarios. The scenarios consider the macroeconomic environment at both domestic and international levels. Overall, macroeconomic growth is a key driver for ICT growth because it supports investments, innovation capacity and the ability to capture the technology and market opportunities. Forecasts of alternative GDP/GNI* growth trends for the period 2018–2022 were developed, taking into account the Irish Department of Finance's Economic and Fiscal Outlook 2018 and the main public sources including the IMF and Eurostat. ICT spending trends sourced from IDC's BlackBook database as well as unemployment dynamics were also considered.

- Main uncertainties: The highest uncertainty concerns Brexit and its consequences. Even though the UK is still formally in the European Union, many stakeholders are anticipating decisions such as the relocation of company offices and employees. However, the two-year transition period expected after the exit on March 29, 2019 means that major impacts of Brexit may occur after 2021, at the end of the forecast period. But the uncertainty around negotiations and even the conditions of the potential transition period is extremely high. The border with Northern Ireland
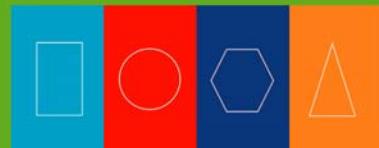
has emerged as a major stumbling block. Apart from Brexit, other main uncertainties concern the possibility of major geopolitical shocks reducing global growth and therefore impacting the pace of growth in Ireland, which is a small open economy strongly influenced by global demand.

### ICT Market Factors

The ICT innovation and technology trends described in the previous chapters are dramatically changing ICT delivery and business models, as well as the interaction between the producer, vendor and user industries as well as consumers. The main factors shaping demand for ICT skills are the growth of the ICT industry, driven by foreign and domestic investments, the pace of adoption of ICT innovation in Ireland, in Europe and the world, the ability of the Irish industry to capture the opportunities offered by technology innovation, the change of the type of skills requested and the increasing polarisation between high- and low-level skills, with higher demand for the former and lower demand for the latter.

- Main uncertainties: These concern the level and type of mismatch between the type of skills required and those on offer, the level of recruitment of foreign talent to fill the supply gap and the ability to overcome the gender gap by attracting more females to ICT careers (which may go a long way towards filling the demand-supply gap). The move towards digital transformation requires a deep cultural change and adaptation of business processes as well as products and services, which may require longer than expected today. For example, there is uncertainty about the speed of digital transformation in the Irish public sector, which has higher inertia and change barriers than most other sectors.

### Global Megatrends

The ICT industry is global, and the current technology shift is driven by worldwide trends. The pace of technology innovation is relentless and is not likely to slow down. From this point of view, Ireland can only deal with and try to exploit these trends.

- Main uncertainties: The pace of digital transformation may be faster or slower, as all countries face the same problem of cultural and technological change. This may influence global demand for products and services developed by the multinationals based in Ireland. The other main uncertainty concerns the level of external competition from other countries in Europe or Asia in attracting international talent, especially in skills areas in high demand, such as AI or cybersecurity.

## Policy and Regulatory Factors

Policy and regulatory factors shape the framework conditions of market development from multiple aspects. In the case of ICT skills we must consider education and training policies, particularly the ICT Skills Action Plan; R&D and innovation investment policies (Ireland's Innovation 2020 strategy, startup and entrepreneurship policies); fiscal policies, especially affecting multinationals; visa and immigration policies affecting the attraction of talent; and housing and public infrastructure policies. These are policies decided and implemented by the Irish government within the framework of EU policies. But we must also consider global European policies, specifically the Digital Single Market strategy and the GDPR, which have a strong influence on the ICT market.
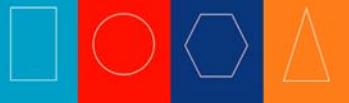
- Main uncertainties: All these policies represent uncertainties, as their implementation and outcomes are never completely certain. For example, there is still uncertainty about the ability of enterprises to exploit the opportunities of GDPR, which came into force in May 2018, and the level of harmonisation of data protection regulation, which will effectively happen. The main uncertainties concern the education system reform (ability to increase supply fast enough to meet new demand), the potential changes in fiscal conditions for multinationals and the government's ability to solve the housing shortages problem.

## Demand Scenarios: An Overview

The three scenarios designed for this study are as follows:

- Keep Running to Win (baseline or most likely scenario), where the continuation of healthy ICT market and macroeconomic growth trends as well as neutral Brexit impacts drive a dynamic increase in demand resulting in approximately 139,000 ICT skills demanded in 2022.

- Dancing with the Stars (High Growth Scenario), where the Irish ICT market moves into even quicker growth, thanks to faster than expected adoption of ICT innovation and strong worldwide demand trends; the ICT industry improves its competitiveness (more startups, Irish multinationals moving higher up the value chain); Ireland captures new opportunities opened by innovation, for example by becoming a leading hub for cloud-based data platforms in Europe. This pushes the ICT skills demand 5% higher than in the previous scenario, but with higher risks of a demand-supply gap.

- Shaken by Cold Winds (Low Growth Scenario), where negative external geopolitical shocks, negative "hard" Brexit impacts, changes in fiscal conditions or world market conditions result in ICT multinationals reducing their investments in Ireland, resulting in weaker than expected ICT adoption and ICT market growth. This eventually results in an ICT skills demand in 2022 that is 27% lower than in the baseline scenario.

### Central Scenario: Keep Running to Win

In this scenario, the Irish ICT market continues to grow rapidly driven by the fast pace of technology innovation, high public and private investments, and a good pace of adoption of digital innovation by user sectors. Irish enterprises engage in digital transformation and the public sector starts doing so as well, with patchwork success across Ireland depending on the local conditions and willingness of local actors.
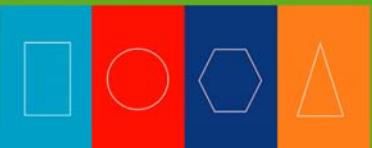
**Figure 31: Central Scenario — Keep Running to Win**



Source: IDC, 2018

- The macroeconomic conditions are favourable, with healthy growth in the GNI* (+4.1% CAGR) in the period 2018–2022 and a decrease in the unemployment rate to 5.5%. Global demand continues to play a strong role in the Irish economy. International crises happen but do not have a sustained negative impact on the global economy. No major financial crisis occurs, even though there are some ups and downs in the financial and stock markets.

- The Irish industry keeps pace with competitors and achieves some growth.

- The technology shift demands new skills (such as AI and cybersecurity) and this results in mismatches between demand and supply of skills, with rapidly increasing demand for high-level skills.

- A "soft" Brexit achieves an acceptable compromise between the UK and the EU on the Northern Ireland border, so that trade remains open and Irish supply chains are not disrupted. Overall, the Brexit impact on the job market is neutral.

- The policy environment evolves to ensure favourable framework conditions for the Irish ICT market. First of all, Ireland's Innovation 2020 R&D strategy is successfully implemented, with R&D investments reaching 2.5% of GDP by 2020 and remaining at this level afterwards. This feeds into the ICT value chain and helps to generate knowledge and skills driving new digital products and services. The development of digital innovation hubs and excellence centres at the regional level contribute to the competitiveness of the industry and the capability of the economic system to adopt digital innovation, favouring industry-research cooperation.
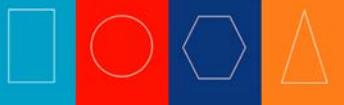
- Ireland's position as an attractive country for talent and multinationals remains strong. In particular, there are policy initiatives to provide affordable housing and improve public transport. The National Planning Framework "Ireland 2040" plans for fast population growth mainly outside Dublin and provides public investments to address the public infrastructure deficit. Urban renewal initiatives in cities like Cork and Galway can help attract young ICT professionals.

- Fiscal conditions for multinationals may change, given the ongoing work by the OECD and national governments to increase the tax burden on ICT multinationals and connect it more closely with the markets where they collect their revenues. However, this does not discourage multinationals in Ireland or push them to leave the country.

- Finally, in this scenario the ICT Skills Action Plan successfully achieves its objectives of reducing the gap between demand and supply, leveraging more active collaboration with industry to attract talent to ICT and to promote awareness of the relevance and attractiveness of ICT careers.

Impacts

The demand for high-level ICT skills will show healthy growth over the period with a CAGR of 8.5%, as shown in Table 2. Growth is especially driven by the ICT sector (9.3%) but demand is also stronger in the other sectors than was the case prior to 2016 as innovation technology adoption increases. Demand for computing skills will grow faster than demand for electronics and electrical engineering skills in the period, as shown in Table 3.

Table 2: Keep Running to Win — Demand for High-Level ICT Skills by Sector, 2016-2022

|  | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | CAGR 2017-22 |
|---|---|---|---|---|---|---|---|---|
| Broad ICT Sector | 58,588 | 63,570 | 68,940 | 75,070 | 82,140 | 90,070 | 98,980 | 9.3% |
| Other Sectors | 26,927 | 28,820 | 30,640 | 32,660 | 34,920 | 37,420 | 40,160 | 6.9% |
| Total | 85,515 | 92,390 | 99,580 | 107,730 | 117,060 | 127,490 | 139,140 | 8.5% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018

Table 3: Keep Running to Win — Demand for High-Level ICT Skills by Type, 2016-2022

|  | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | CAGR 2017-22 |
|---|---|---|---|---|---|---|---|---|
| Computing | 68,970 | 74,820 | 81,220 | 88,530 | 96,940 | 106,340 | 116,870 | 9.3% |
| Electronic & Electrical Engineering | 16,545 | 17,570 | 18,360 | 19,200 | 20,120 | 21,150 | 22,270 | 4.9% |
| Total | 85,515 | 92,390 | 99,580 | 107,730 | 117,060 | 127,490 | 139,140 | 8.5% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018
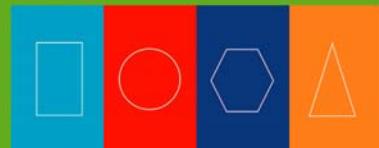
The broad ICT sector is the main "consumer" of ICT skills for both computing and electronic and electrical engineering skills, as shown in Figures 32 and 33.

**Figure 32: Keep Running to Win — Demand for High-Level ICT Skills by Sector, 2016–2022**
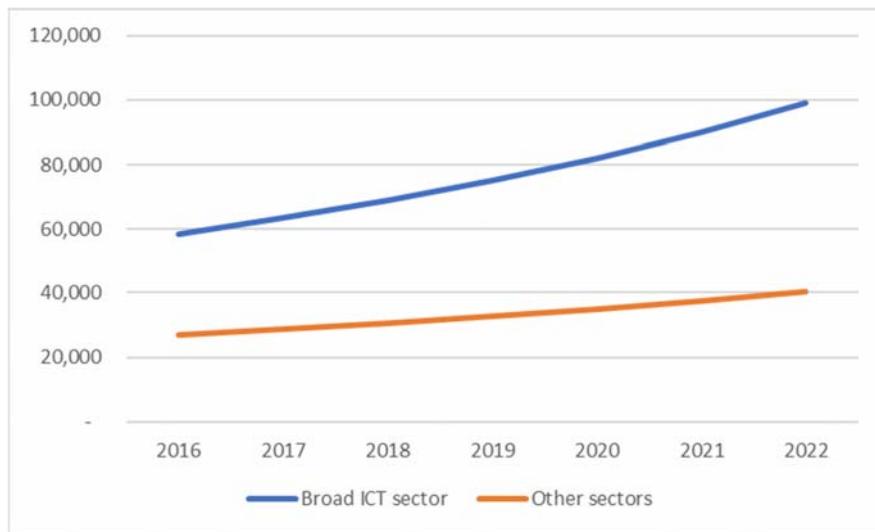


Note: 2016 numbers include vacancies.
Source: IDC, 2018

**Figure 33: Keep Running to Win — Demand for High-Level ICT Skills by Type, 2016–2022**
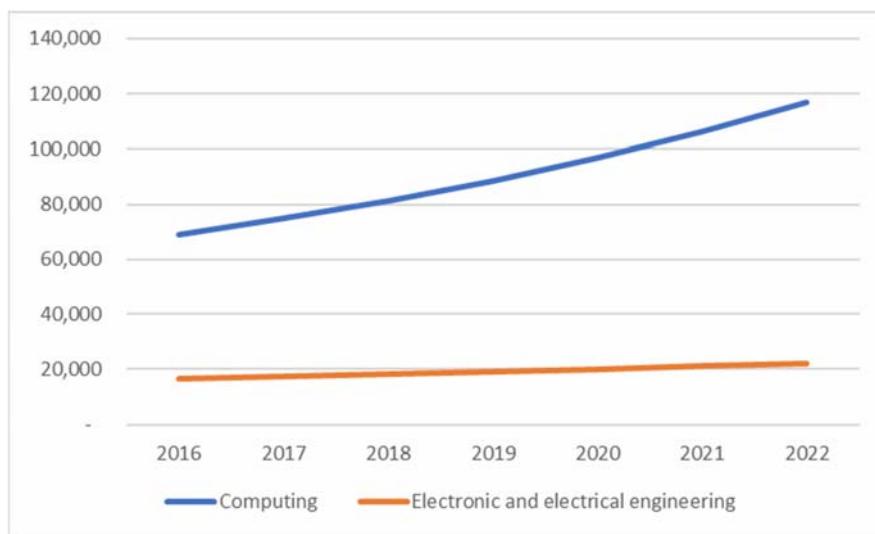


Note: 2016 numbers include vacancies.
Source: IDC, 2018

### Demand by NFQ Level

The complexity of ICT means that employers are mostly demanding NFQ Level 8+ for both computing and electronic and electrical engineering skills, as was also clear from the Enterprise
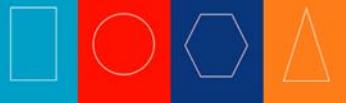
Survey discussed in a previous section of this study. However, there is also a realisation that these skills are harder to find and therefore Level 6/7 skills, perhaps with more initial training, should increasingly be considered to meet the demand. This is also reflected in the forecast of the ICT skills by NFQ Level, as presented in Figure 34 and Table 4 for computing and Figure 35 and Table 5 for electronic and electrical engineering, although Level 8+ demand continues to grow the strongest.

**Figure 34: Keep Running to Win — Demand for High-Level Computing Skills by NFQ Level, 2016-2022**
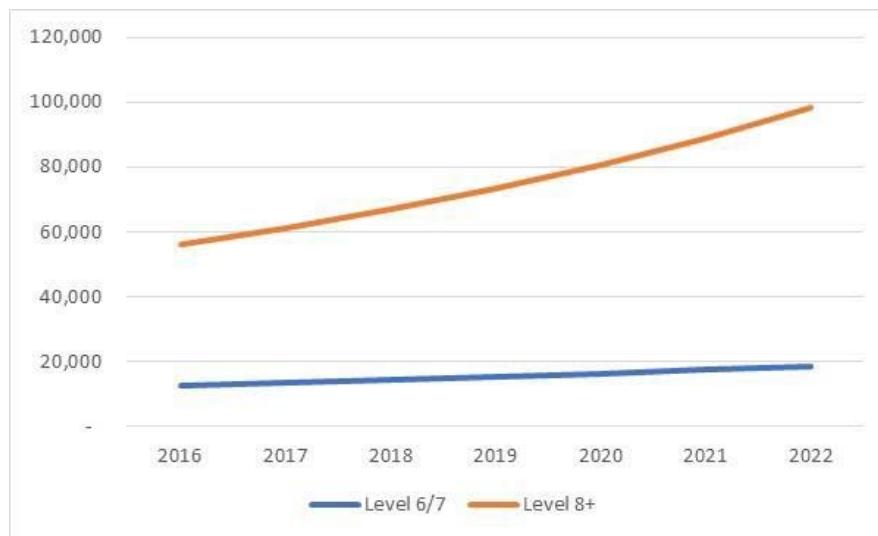


Note: 2016 numbers include vacancies.
Source: IDC, 2018

**Table 4: Keep Running to Win — Demand for High-Level Computing Skills by NFQ Level, 2016-2022**

| | High-Level ICT Skills Demand - COMPUTING by NFQ Level | | | | | | | |
| | | | | | | | | CAGR |
| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2017-22 |
|---|---|---|---|---|---|---|---|---|
| Level 6/7 | 12,805 | 13,530 | 14,350 | 15,280 | 16,330 | 17,470 | 18,710 | 6.7% |
| Level 8+ | 56,165 | 61,290 | 66,870 | 73,250 | 80,610 | 88,870 | 98,160 | 9.9% |
| Total | 68,970 | 74,820 | 81,220 | 88,530 | 96,940 | 106,340 | 116,870 | 9.3% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018
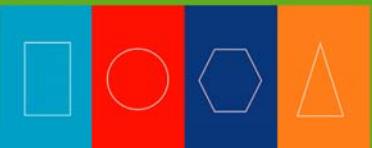
**Figure 35: Keep Running to Win — Demand for High-Level Electronic and Electrical Engineering Skills by NFQ Level, 2016–2022**
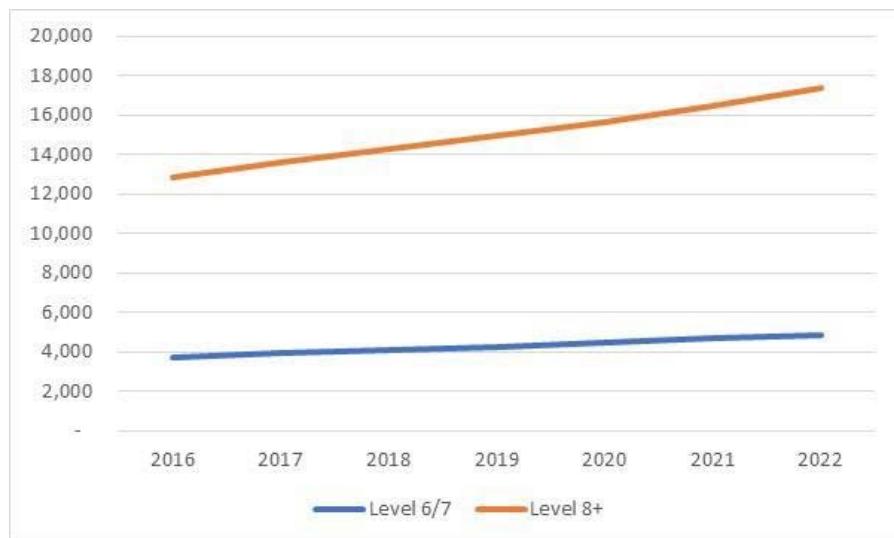


Note: 2016 numbers include vacancies.
Source: IDC, 2018

**Table 5: Keep Running to Win — Demand for High-Level Electronic and Electrical Engineering Skills by NFQ Level, 2016–2022**

| | High-Level ICT Skills Demand - ELECTRICAL ENGINEERING by NFQ Level | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | CAGR 2017-22 |
| Level 6/7 | 3,714 | 3,930 | 4,090 | 4,260 | 4,450 | 4,660 | 4,880 | 4.4% |
| Level 8+ | 12,831 | 13,640 | 14,270 | 14,940 | 15,670 | 16,490 | 17,390 | 5.0% |
| Total | 16,545 | 17,570 | 18,360 | 19,200 | 20,120 | 21,150 | 22,270 | 4.9% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018

### New Job Openings

The demand forecasts above show the expected total annual employment demand for high-level ICT skills in a specific year. However, when we look at the number of potential job openings arising in a specific year, this includes both new jobs, which have to be filled due to expansion demand, and existing jobs, which have to be filled due to replacement demand such as retirements, job switching to non-ICT professional occupations, emigration and inactivity. Expansion demand is defined as the additional jobs that are created in a specific year and which did not previously exist. Figures 36 and 37 (with the accompanying Tables 6 and 7) illustrate these potential job openings by skills type.

Expansion demand is calculated as the difference in demand for skills between two years, for example, the higher number of skills needed in 2018 over 2017. The calculation of replacement
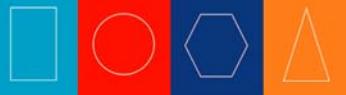
demand is based on input from several sources, conversations with key stakeholders and an assessment of how this results in average replacement proportions for different NFQ levels.

For example, the EGFSN Future Requirement for High-Level ICT Skills in the ICT Sector report from 2008 used a 5% replacement rate for NFQ Level 8+. However, a 2012 CEDEFOP analysis of annual replacement for physical, mathematical and engineering science professionals arrived at 4.4% per year. Furthermore, in 2016, a report from the Warwick Institute for Employment Research estimated annual replacement rates for the job market as a whole at 2%–4%[18]. Consequently, it is estimated that a gross 4.5% per year replacement rate is a reasonable assumption for NFQ Level 8+. A slightly lower rate at 4% per year for Levels 6/7 is assumed, since skills at these levels are less portable (also abroad) so that the replacement level of people at this level is lower.

**Figure 36: Keep Running to Win — Potential New Openings for High-Level Computing Skills by Replacement and Expansion Demand, 2018–2022**
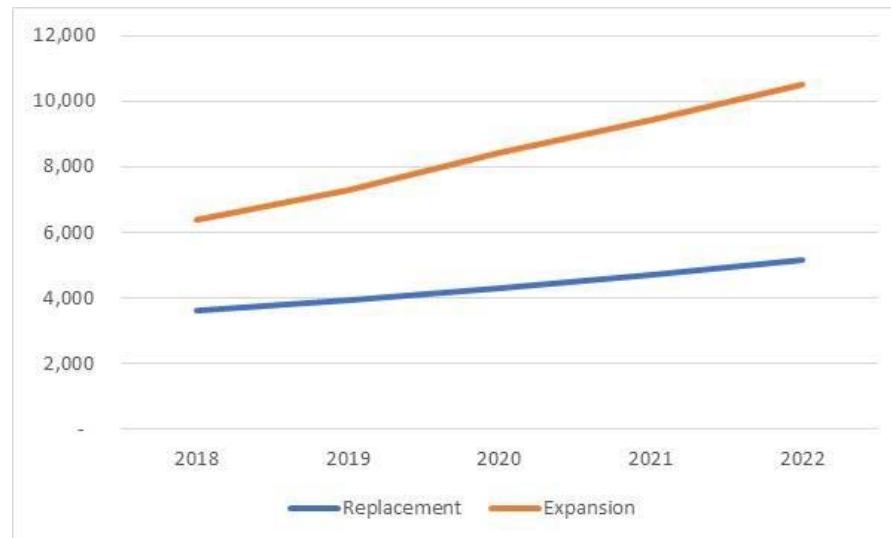


Source: IDC, 2018

**Table 6: Keep Running to Win- Potential New Openings for High-Level Computing Skills by Replacement and Expansion Demand, 2018-2022**

| High-Level ICT Skills Demand - COMPUTING by Replacement, Expansion and Existing Jobs | | | | | |
|---|---|---|---|---|---|
| | **2018** | **2019** | **2020** | **2021** | **2022** |
| Replacement | 3,600 | 3,930 | 4,280 | 4,700 | 5,170 |
| Expansion | 6,400 | 7,310 | 8,410 | 9,400 | 10,530 |
| **Total** | 10,000 | 11,240 | 12,690 | 14,100 | 15,700 |

Source: IDC 2018

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18 Warwick Institute for Employment Futures, "Working Futures 2014-2024", April 2016
(http://dera.ioe.ac.uk/26069/1/Working_Futures_final_evidence_report.pdf)
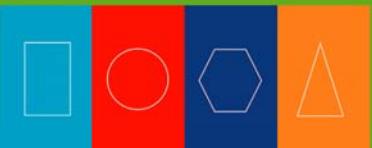
**Figure 37: Keep Running to Win — Potential New Openings for High-Level Electronic and Electrical Engineering Skills by Replacement and Expansion Demand, 2018–2022**
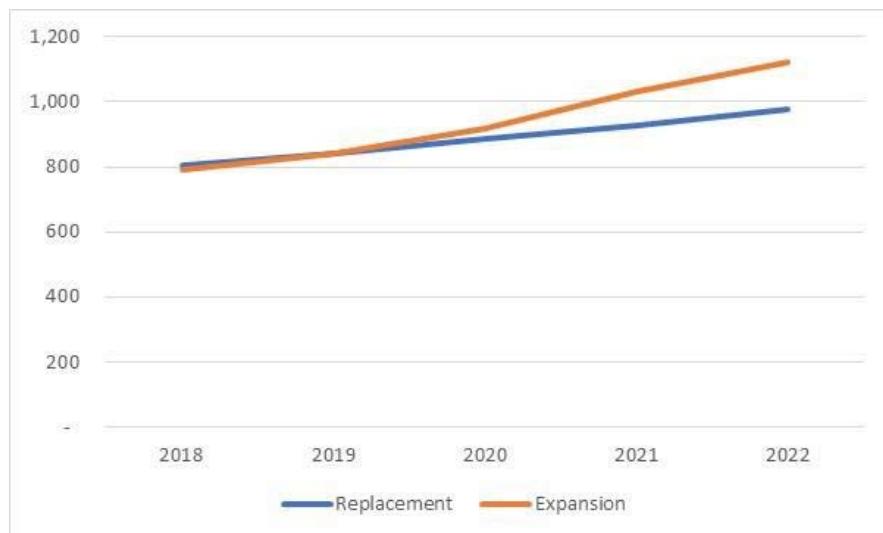


Source: IDC, 2018

**Table 7: Keep Running to Win — Potential New Openings for High-Level Electronic and Electrical Engineering Skills by Replacement and Expansion Demand, 2018–2022**

| | High-Level ICT Skills Demand - ELECTRONIC AND ELECTRICAL ENGINEERING by Replacement, Expansion and Existing Jobs | | | | |
|---|---|---|---|---|---|
| | 2018 | 2019 | 2020 | 2021 | 2022 |
| Replacement | 804 | 840 | 889 | 926 | 975 |
| Expansion | 790 | 840 | 920 | 1,030 | 1,120 |
| **Total** | 1,594 | 1,680 | 1,809 | 1,956 | 2,095 |

Source: IDC, 2018

Table 8 below provides some of the underlying numbers for potential job openings by skills type and by NFQ level. Overall, in the Keep Running to Win scenario, over the period to 2022, it is estimated that there will be almost 73,000 new job openings. Of these, demand for computing skills will still take the lion's share. It is estimated that just under 76% of the potential job openings for high-level computing skills will be for Level 8+, while for electronic and electrical engineering skills, this proportion is slightly higher at 79%.
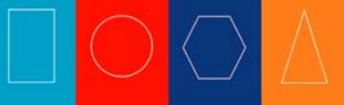
Table 8: Keep Running to Win — Potential Job Openings for High-Level ICT Professionals by Skill Type and NFQ Level, 2018-2022

| | | 2018 | 2019 | 2020 | 2021 | 2022 | Total Job Openings 2018-2022 |
|---|---|---|---|---|---|---|---|
| Computing | Level 6/7 | 1,410 | 1,560 | 1,700 | 1,840 | 1,990 | 8,500 |
| | Level 8+ | 8,590 | 9,680 | 10,990 | 12,260 | 13,710 | 55,230 |
| | **Total** | **10,000** | **11,240** | **12,690** | **14,100** | **15,700** | **63,730** |
| Electronic & Electrical Engineering | Level 6/7 | 324 | 340 | 369 | 396 | 415 | 1,844 |
| | Level 8+ | 1,270 | 1,340 | 1,440 | 1,560 | 1,680 | 7,290 |
| | **Total** | **1,594** | **1,680** | **1,809** | **1,956** | **2,095** | **9,134** |
| **Total Potential Job Openings** | | **11,594** | **12,920** | **14,499** | **16,056** | **17,795** | **72,864** |

Source: IDC, 2018

## Scenario 2: Dancing with the Stars

This scenario foresees the Irish ICT market accelerating from an already positive trend to a faster development path. This could happen due to a particularly favourable combination of events, excellent management by the Irish government and strong initiatives by private industry. Even if this scenario is optimistic, it does highlight the potentially high gains.

Figure 38: Scenario 2 — Dancing with the Stars



Source: IDC, 2018

In this scenario:

▪ Macroeconomic conditions improve even more than in the previous scenario, with Irish GNI* growth reaching a 4.8% CAGR, the world economy continuing in excellent health and global demand accelerating and sustaining growth in Ireland. The main technology challenges are solved as the global shift towards the new wave of technologies incorporating artificial
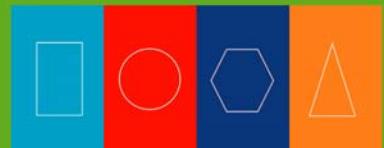
intelligence moves quickly. Stimulated by technology availability and confidence in demand, more and more enterprises engage in digital transformation so that by 2022 a majority of large and medium organisations have become digital, data-driven companies. The public sector overcomes its barriers and is able to join in digital transformation; healthcare in particular shows strong productivity and efficiency gains thanks to digital transformation.

- Ireland does not follow but rather anticipates and exploits these trends. The main change compared with the previous scenario is the change of pace in the Irish ICT industry, with many startups and spin-offs pioneering new products and services and some Irish multinationals moving up the value chain and conquering the European and global markets. To do so, the Irish ICT industry, supported by public authorities, succeeds in recognising and exploiting new innovation opportunities- for example by becoming a global hub for cloud-based data platforms.

- A "soft" Brexit minimises the disadvantages for Ireland, while jobs are relocated from the UK to Ireland (financial/computing services especially). Campaigns to make Ireland an attractive destination succeed, and the visa policy for example is revised to open the door even more to students and highly specialised skills.

- Policy makers in this scenario ably support private initiatives, for example by increasing R&D investments and incentives for private research investments, by providing incentives and risk capital for innovative startups, and by funding digital innovation hubs and regional excellence centres that also enable small enterprises to experiment with and adopt digital technologies. The Innovation 2020 strategy succeeds fully. Public-private partnerships invest in affordable housing to accommodate incoming workers, while the government improves the availability and quality of public services, such as transportation. IDA Ireland succeeds in attracting investments in most regions outside Dublin and the National Planning Framework "Ireland 2040" provides public investments addressing infrastructure and services.

### Impacts

In terms of the ICT skills market, in this scenario demand climbs quickly and there is a stronger risk of a demand-supply gap. The demand for high-level skills grows particularly quickly. However, thanks to the dynamism of the ICT sector, the number of workers attracted to ICT from other careers increases and enterprises invest more in upskilling and reskilling. The government also invests in initiatives that increase the ICT teaching capacity and the flexibility of the education system, such as accelerated inter-sectoral initiatives (between education sectors) and launching new, shorter courses with non- traditional educators to respond to new skills demand. Collaboration between industry, academia, policy makers and professional bodies results in awareness-raising initiatives in schools and universities, which change the perception of ICT careers as purely technical. This in turn helps to attract more females to ICT careers. Overall, these moves help to respond to the increased demand for ICT skills, thereby avoiding bottlenecks in supply.

In this positive scenario, we will see stronger demand for ICT skills arising both from the broad ICT sector but also from other sectors, as adoption of new technologies and digital transformation
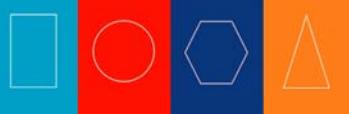
efforts accelerate. Demand will be strong for both computing and electronic and electrical engineering skills and will result in a demand for more than 145,000 ICT practitioners by 2022 — almost 5% higher than in the central scenario (Tables 9 and 10).

Table 9: Dancing with the Stars — Demand for High-Level ICT Skills by Sector, 2016–2022

|  | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | CAGR 2017-22 |
|---|---|---|---|---|---|---|---|---|
| Broad ICT Sector | 58,588 | 63,570 | 69,600 | 76,640 | 84,840 | 94,460 | 105,770 | 10.3% |
| Other Sectors | 26,927 | 28,820 | 30,910 | 33,090 | 35,250 | 37,510 | 39,890 | 6.8% |
| Total | 85,515 | 92,390 | 100,510 | 109,730 | 120,090 | 131,970 | 145,660 | 9.3% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018

Table 10: Dancing with the Stars — Demand for High-Level ICT Skills by Type, 2016–2022

|  | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | CAGR 2017-22 |
|---|---|---|---|---|---|---|---|---|
| Computing | 68,970 | 74,820 | 82,060 | 90,260 | 99,550 | 110,190 | 122,470 | 10.0% |
| Electronic & Electrical Engineering | 16,545 | 17,570 | 18,450 | 19,470 | 20,540 | 21,780 | 23,190 | 5.8% |
| Total | 85,515 | 92,390 | 100,510 | 109,730 | 120,090 | 131,970 | 145,660 | 9.3% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018

Table 11 shows the potential job openings for the positive scenario by skill type and NFQ level.

Table 11: Dancing with the Stars — Potential Job Openings for High-Level ICT Professionals by Skills Type and NFQ Level, 2018–2022

|  |  | 2018 | 2019 | 2020 | 2021 | 2022 | Total Job Openings 2018-2022 |
|---|---|---|---|---|---|---|---|
| Computing | Level 6/7 | 1,560 | 1,720 | 1,860 | 2,050 | 2,290 | 9,480 |
|  | Level 8+ | 9,310 | 10,480 | 11,830 | 13,450 | 15,400 | 60,470 |
|  | Total | 10,870 | 12,200 | 13,690 | 15,500 | 17,690 | 69,950 |
| Electronic & Electrical Engineering | Level 6/7 | 344 | 383 | 403 | 442 | 504 | 2,075 |
|  | Level 8+ | 1,350 | 1,490 | 1,570 | 1,750 | 1,920 | 8,080 |
|  | Total | 1,694 | 1,873 | 1,973 | 2,192 | 2,424 | 10,155 |
| Total Potential Job Openings |  | 12,564 | 14,073 | 15,663 | 17,692 | 20,114 | 80,105 |

Source: IDC, 2018
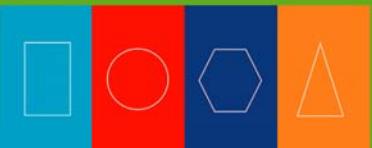
**Scenario 3: Shaken by Cold Winds**

**Figure 39: Scenario 3 — Shaken by Cold Winds**



Source: IDC, 2018

This scenario foresees:

- A negative self-reinforcing cycle (instead of the virtuous development cycle outlined in "Dancing with the Stars"), where less positive global economic conditions discourage investments and weaken global demand with a negative impact on Irish economic growth. A slower pace of digital innovation deprives the economy of the boost to growth potentially given by new digital services and products, while industries find competing in international markets more difficult.

- A major driver of this scenario is an unexpected resistance to digital transformation by enterprises and the population due to reluctance to change and difficulty in adopting new processes and ways of working, compounded by a relatively old working population and lack of specialist skills. Major security breaches of personal data and a widespread mistrust in social media and data platforms may also create a social backlash requiring a longer period of social negotiation before the adoption of innovation, such as digital assistants, is accepted. The need to create new rules for drones or robots to interact with humans, for example, avoiding accidents and managing risks, also slows down their adoption.

- A lower pace of global economic growth could be caused by geopolitical shocks in critical regions, by trade wars fostered by new protectionist policies or by a new financial crisis, if for example the ongoing downward correction of the stock markets does not stop and triggers a new recession. Given the multiple stress areas, it is not difficult to imagine potential negative events. While it is unlikely that they will all happen at the same time, it is instead likely that at least one negative event will happen in the next seven years. In that case, the ultimate impacts on Irish growth will depend on the resilience of the Irish economy.
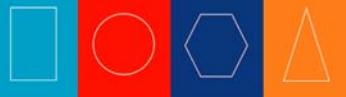
- Another important element in this scenario is a "hard" Brexit, which may recreate a border with Northern Ireland or require complicated arrangements. This would disrupt the supply chains crisscrossing the border, thereby disproportionally damaging some sectors (according to some sources, the agri-food industry would be particularly hit). While a strong direct impact on the ICT sector is unlikely, this situation would definitely disrupt the Irish economy. Even though some gains might be made thanks to relocation of some companies or jobs from the UK to Ireland, the overall impact would be negative.

- In this scenario, Ireland fails to capture sufficiently the emerging innovation opportunities and the Irish industry remains in a slow growth path. Fiscal conditions for multinationals change, for example imposed by the EU, and this results in at least one multinational leaving Ireland, or several of them reducing their activities in the country because it is no longer convenient to concentrate revenues in one country.

- In this context, the Irish government may be unable to maintain the promises of Ireland's Innovation 2020 plan and fail to allocate all the promised R&D investments, contributing to the slowdown of investments. The establishment of digital innovation hubs and excellence centres, though it may be seen as anti-conjunctural and may therefore be maintained, would attract less private support and have difficulty in achieving the hoped-for benefits to stimulate industry collaboration. Without proactive public policies, costly or insufficient housing and public services would reduce Ireland's attraction to foreign talent and raise the cost of local talent.

**Impacts**

In this scenario, the demand for ICT skills would still grow but more slowly and there would still be a mismatch between skills required and skills available, as the public-private effort to innovate education and training would be less dynamic and effective.

Overall, the demand for ICT skills by 2022 would be some 23,000 positions fewer than in the central scenario. Growth in the broad ICT sector will be especially hit as the attractiveness of Ireland for multinationals will be dampened (see Table 12). Demand for both computing and electronic and electrical engineering skills will be lower than in the central scenario (see Table 13).
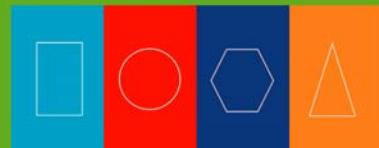
### Table 12: Shaken by Cold Winds — Demand for High-Level ICT Skills by Sector, 2016–2022

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | CAGR 2017-22 |
|---|---|---|---|---|---|---|---|---|
| Broad ICT Sector | 58,588 | 63,570 | 66,870 | 70,090 | 73,390 | 76,870 | 80,390 | 5.4% |
| Other Sectors | 26,927 | 28,820 | 30,130 | 31,440 | 32,640 | 33,850 | 35,090 | 4.5% |
| Total | 85,515 | 92,390 | 97,000 | 101,530 | 106,030 | 110,720 | 115,480 | 5.1% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018

### Table 13: Shaken by Cold Winds — Demand for High-Level ICT Skills by Type, 2016–2022

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | CAGR 2017-22 |
|---|---|---|---|---|---|---|---|---|
| Computing | 68,970 | 74,820 | 78,720 | 82,850 | 86,930 | 91,060 | 95,250 | 5.5% |
| Electronic & Electrical Engineering | 16,545 | 17,570 | 18,280 | 18,680 | 19,100 | 19,660 | 20,230 | 3.4% |
| Total | 85,515 | 92,390 | 97,000 | 101,530 | 106,030 | 110,720 | 115,480 | 5.1% |

Note: 2016 numbers include vacancies.
Source: IDC, 2018

Table 14 shows the potential job openings for the negative scenario by skill type and NFQ level.

### Table 14: Shaken by Cold Winds- Potential Job Openings for High-Level ICT Professionals by Skills Type and NFQ Level, 2018-2022

| | | 2018 | 2019 | 2020 | 2021 | 2022 | Total Job Openings 2018-2022 |
|---|---|---|---|---|---|---|---|
| Computing | Level 6/7 | 950 | 980 | 930 | 920 | 900 | 4,680 |
| | Level 8+ | 6,440 | 6,820 | 6,990 | 7,230 | 7,500 | 34,980 |
| | Total | 7,390 | 7,800 | 7,920 | 8,150 | 8,400 | 39,660 |
| Electronic & Electrical Engineering | Level 6/7 | 313 | 236 | 250 | 273 | 288 | 1,360 |
| | Level 8+ | 1,200 | 980 | 1,010 | 1,150 | 1,170 | 5,510 |
| | Total | 1,513 | 1,216 | 1,260 | 1,423 | 1,458 | 6,870 |
| Total Potential Job Openings | | 8,903 | 9,016 | 9,180 | 9,573 | 9,858 | 46,530 |

Source: IDC, 2018
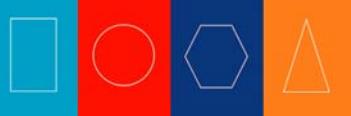
# Chapter 5- Key Findings Informing the ICT Skills Action Plan

This section presents the key findings of the study intended to inform the new ICT Skills Action Plan. This is based on the synthesis of the most relevant ideas and suggestions for future actions provided by stakeholders aimed at satisfying the emerging demand for ICT skills and boosting the quantity, quality and diversity of the supply of ICT skills in Ireland. It is clear that with the number of projected Level 8+ graduates in 2018 (mainstream, ICT conversions and Springboard) at 5,390, and potential job openings for this level of degree at 10,090, that other actions need to be taken.

**Digital Technologies Create Demand for New Skills**

The global technology trends described earlier in this study outline a range of new skills that are in growing demand around the world. The digitisation trend is strong in all regions worldwide and there is still a scarcity of skills that can design, develop and implement many of these technologies. Digital transformation is now an existential concern for many organisations and has become a strategic business imperative. Organisations, almost regardless of age or industry, are striving to become "digital" in the way their executives and employees think, what they produce and how they operate.

This creates strong demand globally as well as in Ireland for technologies and services that can help organisations achieve these goals. It is predicted that, by 2021, at least 50% of global GDP will be digitised, with growth in every industry driven by digitally enhanced offerings, operations and relationships.

At the heart of the digital transformation trend is the blurring of the lines between ICT and business. Naturally, deep technology skills are still needed to be able to take advantage of the new technologies, such as IoT, AI and blockchain. However, it is also crucial to have access to skills that understand how to bridge between ICT and business, understand how the technologies can be brought to bear in specific industries, and understand the business process implications. For this reason, the potential source pool for ICT skills may be broader than previously.

**Challenges and Opportunities — The View from the Stakeholders**

The analysis carried out in the study highlights how the skills needs of the ICT market are evolving rapidly both in quality and quantity, posing new challenges not only to the education and training system, but to the whole socioeconomic system. For example, attracting more females to ICT careers does not mean simply recruiting more females in STEM courses, but also changing common views about ICT being only for the extremely technology-minded and providing working conditions enabling the reconciliation of work and family life. Attracting new talent from abroad to fill the supply gap means also providing attractive work and living conditions, as stakeholders pointed out, underlining the need for affordable housing. And given the relentless pace of technology innovation, only life-long learning processes integrated with and complementary to the education process for young people may satisfy the continuously evolving demand for new skills. Stakeholders underlined strongly the continuing mismatch between the skills available and those needed. The dynamics of digital transformation specifically do not affect only the specialised ICT workforce but involve all
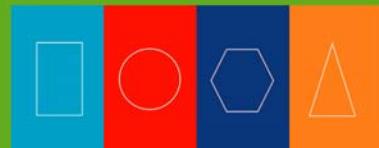
human resources in the organisation who must be trained in digital skills at various levels of competence, depending on their role and involvement with digital processes. In the work environment, the boundary between ICT practitioner skills and business skills is blurring, and this again poses new challenges in terms of upskilling and retraining.

Stakeholders are very aware of these new challenges and many of them mentioned the need for a kind of "reset" of traditional ICT education and training policies, accompanied by a "rebranding" of the ICT profession, highlighting its pervasiveness in all sectors and company functions. They are also conscious of the need for stronger collaboration between industry and academia to achieve these goals.

Stakeholders underlined the need for urgent action to deal with the increasing mismatch between skillsets available and the need for new emerging skills (in fields such as data analytics, artificial intelligence and cybersecurity). There is also increasing demand for soft skills, such as teamwork and problem-solving capabilities, not well provided by the education system. Some of the initiatives they suggested go beyond the scope of the ICT skills action plan, but they are all relevant to reduce the potential demand-supply gap.

In summary, the main challenges identified by stakeholders that must be overcome to improve the supply of ICT skills are as follows:

- Improve the flexibility and productivity of the education and training system
- Multiply apprenticeships and internships
- Change the image and perception of ICT careers
- Attract more females to ICT careers
- Improve Ireland's attractiveness as a destination for talent

On the other hand, it is also important for Ireland to create favourable conditions to sustain the local industry demand for ICT skills, so that professionals who invested time and effort to learn these skills can be fruitfully employed and enterprises can leverage their competences. From this point of view, the stakeholders underlined the following challenges that must be met:

- Enable Ireland to capture the opportunities of new technologies
- Attract talent to other regions beyond Dublin

**Meeting Supply-Side Challenges**

**Improving the Flexibility and Productivity of the Education and Training System**

Stakeholders broadly approved of the measures enacted by the current ICT skills action plan to increase the supply of ICT graduates but complained of the insufficient level of investments and speed of action compared to the urgency of needs. To accelerate transformation and respond faster to emerging needs, stakeholders suggested that the Irish government should:
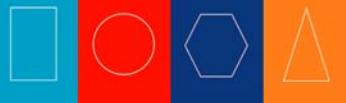
- Support initiatives to increase the recruitment of students with the appropriate aptitudes for computer science/STEM in all the sectors of the education system and at the transition points between sectors (primary, post-primary, higher education). This could include initiatives to increase the capacity of computer science teaching in the post-primary sector: for example, the Irish government could establish a competitive fund to invite higher education institutions to bring forward proposals to accelerate the delivery of the computer science curriculum in the post-primary sector, launching higher education specialist programmes of study (often referred to as denominated programmes) in fields such as cybersecurity, but also more general programmes for those who do not want to specialise too early.
- Direct the education system to launch new, short courses with non-traditional educators to respond to new skills demand and to help increase graduate output.

There is an issue of teaching capacity as the number of STEM teachers is limited. To solve this, the stakeholders suggested that the Irish government should:
- Increase investments in the education system to open more teaching positions in the STEM area
- Introduce incentives for STEM teachers, as they have many other career opportunities

Finally, the stakeholders recommended the following:
- Accelerate the introduction of coding in primary schools and introduce digital skills from the early years. Even if this does not have immediate impacts on the jobs market, introducing children and their families to an active rather than passive approach to ICT, showing how simple and creative coding can be, has an immense social and cultural impact.

### Multiplying Apprenticeships and Internships

Apprenticeships and internships represent the bridge between the learning and work environment, between education and industry. The stakeholders recommended intensifying them, and more specifically to leverage the collaboration between industry and academia to:
- Accelerate the development of specific apprenticeships to feed the supply of new skills.
- Expand internships in collaboration between industry and the education system, for example by encouraging enterprises to pose specific challenges or research projects to university, to be solved through the work of an intern. This is also a way to incentivise SMEs to invest in internships.
- Attract transition year students to ICT via internships.

### Change the Image and Perception of ICT Careers

The stakeholders were clear that the ICT industry should take a leading role in "rebranding" the ICT profession to emphasise its new pervasiveness and wider scope than in the past. Potential initiatives could include:

- Promoting awareness campaigns about the relevance and role of ICT in all sectors, leaving behind the deep technology skills but also about understanding how technology can be applied
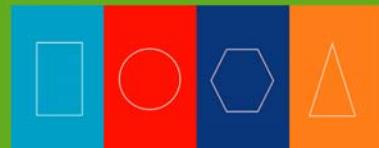
in specific functions or sectors, such as healthcare or agriculture, using clear language with broader appeal.

- Industry associations could organise visits and presentations starting from primary school, to promote the ICT profession, providing new role models and career perspectives, especially for females.

### Attract More Females to ICT Careers

This is not an easy goal. In the 2012–2018 ICT skills action plans improving the gender balance was already an objective, but currently 85% of entrants and 80% of current ICT graduates are male. There are multiple reasons for this, many of which have cultural roots or depend on the way careers are managed in enterprises. However, the stakeholders suggested that stronger and more focused efforts could be made, including:

- Addressing awareness-raising initiatives about ICT jobs, particularly with female students
- Identifying and promoting female role models in the ICT profession
- Paying special attention to gender issues when trying to "rebrand" the ICT profession (as discussed in the previous paragraph)
- Promoting female-only initiatives such as hackathons
- Making sure that all-girl post-primary schools offer the full range of honours Leaving Certificate subjects in mathematics and the major science areas, so that girls are not discouraged from pursuing those subjects

### Improve Ireland's Attractiveness as a Destination for Talent

Stakeholders approved of the policy measures implemented in the past few years to attract talent, which in their opinion should be continued and reinforced through:

- Renewed investments in promoting the Ireland brand as a talent destination
- Expansion of visa/work permit schemes, for example to include the animation industry

By far the most urgent issue potentially weakening Ireland's appeal, according to the stakeholders, was the lack of affordable housing and the inadequacy of public services, particularly in Dublin and Cork. Therefore, the stakeholders recommended the following:

- Increasing the provision of affordable housing
- Improving public infrastructure and transportation services

### Meeting Demand-Side Challenges

### Enable Ireland to Capture the Opportunities of New Technologies

Stakeholders underlined the potential opportunities open to Irish industry through new technology trends. To promote these opportunities the following actions could be taken:

- Develop Ireland as a centre of expertise for specific technology areas, like Tubingen in Germany, for example, which is emerging as an AI hub for data-driven innovation. Ireland
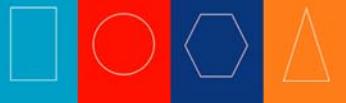
already hosts many leading BDA companies such as Google, IBM, SAP and Microsoft, and can leverage this to bring the ICT industry, academia and the government together under one umbrella to address key issues such as the talent gap in Big Data and analytics.

- Support R&D efforts in collaboration between universities/industry, following the model of the leading US universities (such as MIT and Stanford).

- Support entrepreneurship and startups by increasing available risk capital and promoting accelerators and incubators.

**Attract Talent to Other Regions Beyond Dublin**

Today, most of the demand for high-level ICT skills is concentrated in Dublin, which is one of the reasons for the scarcity of housing and over-exploited infrastructures. A way to rebalance this would be to:

- Develop regional digital innovation hubs favouring the interaction between industry and research, particularly SMEs, thereby creating job opportunities for talent outside Dublin and reducing the pressure on housing and infrastructure in the crowded capital. Also, urban renewal initiatives for cities like Cork and Galway could help to attract ICT professionals who appreciate dynamic urban living.

- Leverage the implementation of the IDA Ireland strategy "Winning: Foreign Direct Investment, 2015–2019", which is targeting an increase of 30-40% of investments to be attracted to all regions outside Dublin, and the National Planning Framework "Ireland 2040", which plans for fast population growth mainly outside Dublin and provides public investments to address the public infrastructure deficit.
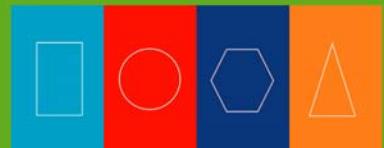
# Conclusions

The principal goal of this study has been to assess the likely future demand for ICT skills in Ireland in the period 2017-2022 and to identify the need for action to avoid a demand-supply gap and respond to industry requirements. A previous study carried out in 2012-2013 had accurately forecast the particularly rapid increase in ICT skills demand in Ireland to date.

Given the relentless pace of technical innovation, this study predicts that the demand for ICT skills in Ireland will continue to grow at a CAGR of 8.5% (in the most likely scenario, "Keep Running to Win"), corresponding to 139,140 ICT practitioner jobs in 2022. Demand could be 5% higher in the "Dancing with the Stars" scenario, with the CAGR climbing to 9.3%, corresponding to 145,660 ICT practitioner jobs in the same year. Or, if less favourable economic and ICT market growth conditions prevail (the "Shaken by Cold Winds" scenario), ICT skills demand will grow by "only" 5% to create 115,480 ICT positions by 2022. Even in the case of the more pessimistic scenario, the increase in ICT skills demand is remarkable, while the rate of increase in the "Dancing with the Stars" scenario is extremely high. This confirms the need for a new ICT Skills Action Plan and for proactive measures to increase the number of graduates and attract talent from other careers or from overseas.

The analysis carried out in the study highlights how the skills requirements of the ICT market are swiftly evolving not just in quantity but also in quality. However, this poses new challenges not only to the education and training system, but to the whole socioeconomic system.

The number one concern mentioned by stakeholders is the disparity between skills needed and those available in the labour market. This is not really a "mismatch" in the normal definition of the word though — that is, a surplus of some skills and a scarcity of others. Rather, many of the skills in demand are so new that the education system has not had the time to produce graduates in these areas. The mismatch, in effect, reflects a more general scarcity of skilled ICT personnel, exacerbated by the large number of ICT firms based in Ireland. In some market segments, such as animation and computer games, the demand for skills is growing exponentially.

All things considered, these new challenges are very much top of mind for Irish stakeholders, who voiced that there need to be significant changes to the way ICT careers are promoted as well as a rethink and, possibly, a "reset" in terms of the traditional approach to ICT education and training. In line with this, they are also conscious of the need for stronger collaboration between industry and academia to achieve these goals. There is also a sense of urgency that many industry stakeholders feel is not shared by the policy establishment. The education system has very long innovation cycles — changes in curricula result in new graduates only three to five years or so later — but nevertheless short-term impact actions could be taken. Non-conventional ideas such as using non-traditional teachers for new skills were advanced in the discussion. Their recommendations should be carefully considered for the forthcoming ICT skills action plan.
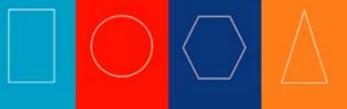
# Appendix I: Terms of Reference

## Expert Group on Future Skills Needs: Forecasting the demand for ICT Practitioners in Ireland over the period 2017-2022

### Aim of Project

The aim of this project is to forecast the demand for ICT Practitioners skills over the period 2017-2022 arising both within the ICT sector and across other sectors of the economy. The forecast will be an input into the planned update of the National ICT Skills Action Plan. Over the period 2011-2016 ICT Practitioner employment increased from 65,350 to 81,600 somewhat higher that the central forecast within the EGFSN 2013 report. This represented a 25% increase in employment over the 5 year period.[19] Indications are that demand for ICT Practitioners skills is now growing stronger. It is essential that the demand for ICT Practitioners skills is forecast so that the necessary actions can put in place to ensure the required supply. The Expert Group on Future Skills Needs are the main client.

### Background

This work will be an input into the planned update of Ireland's National "ICT Skills Action Plan, 2014-2018"[20]. Preparation of the 2014-2018 Action Plan was informed by a forecasting and research exercise commissioned by the Expert Group on Future Skills Needs in 2013 and published later that year in the EGFSN report "Addressing Future Demand for High Level ICT Skills"[21].

The focus of the 2013 EGFSN study was on the demand over the period 2013–2018, arising from within (a) the broad ICT sector and (b) across other sectors of the economy - in terms of ICT skills at National Framework of Qualifications (hereafter NFQ) Levels 6/7 and NFQ Level 8/9/10. The study presented two plausible demand scenarios for high-level ICT skills, using as a baseline the 2011 ICT practitioner employment level of 65,350. These were:

- The Central Growth Scenario which was anticipated the most likely to occur. Under this scenario the demand for ICT Practitioners was forecast to grow at a Compound Annual Growth Rate (CAGR) of nearly 5% over the forecast period.

- The Higher Growth Scenario - under which the demand for ICT Practitioners was forecast to grow at a Compound Annual Growth Rate of over 7.2% over the forecast period.

The development of the "ICT Skills Action Plan, 2014-2018" was informed by the detailed work of the EGFSN High-Level ICT Skills study. This Action Plan contains 22 actions, which drew on recommendations contained in the EGFSN study, aimed at boosting both the quantity and quality of supply of high-level ICT skills to meet the demand projected by the Central Growth Scenario. These actions are being delivered with the support of Government, State Agencies, Education and training

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19 Source: CSO Census 2016 Population at Work by Detailed Occupational Group and Broad Industry Group.
20 http://www.skillsireland.ie/media/14042014-ICT_Skills_Action_Plan-Publication.pdf
21 http://www.skillsireland.ie/media/04112013-Addressing_ICT_Skills-Publication.pdf
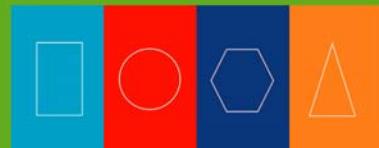
providers, employers and other related stakeholders. As highlighted in the Expert Group study, ICT Practitioner skills demand is being driven by several factors including:

- An expansion of existing companies;
- The continuing flow of inward investment;
- The formation of new enterprise start-ups;
- A shift within sectors towards more high value-added activities; and
- Technological convergence creating new business opportunities, such as for cloud computing, digital media, energy efficiency, e-health and 'big data' analytics activities.


**Rationale for Current Study**

In 2013 the Higher Growth Scenario for ICT Practitioners demand was considered relatively unlikely in the short term, but more likely in the medium to long term if the economy recovered and companies made the necessary investments in technologies and skills. An assessment of several strong indicators is that during 2016 Ireland has moved towards the Higher Growth Scenario.


- Over the period 2011 to 2016 ICT Practitioner employment increased by 16,250 from 65,350 to 81,600, representing a 25% increase in employment (See Figure 1).[22] The scale of increase was greater for certain ICT occupations, particularly Programmers and Software Development where employment expanded from 13,240 to 20,113 – by 6,870 and for IT specialist managers which increased from 7,827 to 10,661 – by 2,830. IT User support technicians increased from 4,309 to 5,477 – by 1,168. (See Figure 2). There was a reduction for one of the 14 ICT occupations. Telecommunication Engineers employment fell from 5,196 to 4,193. Despite an increase in Telecommunication business this may be due to technological change and productivity improvements negatively impacting on this occupation[23].


- Preliminary Employment Survey results in early 2017 indicate that IDA Ireland ICT related client firms' full -time employment grew by 8.4% in 2016, while employment in Enterprise Ireland ICT related client firms grew by 9%.


- The Compound Annual Growth Rate (CAGR) was higher for ICT Practitioner occupations employing large numbers such as Programmes and Software Developers (NFQ L8+) where employment increased by a 9% compound annual growth rate. The annual growth rates for individual ICT Practitioner occupations is presented in Figure 3.


- A substantial part of current demand for ICT Practitioners is being met through the Employment Permit system. ICT employment permits comprise the largest number of employment permits issued (33% of total). The number has increased over the last three years. A total of 3,200 ICT permits were issued in 2016 - well above the issuance of up to 2,000 employment permits referenced in the ICT Skills Action Plan 2014-2018. This represented a 28% increase on the

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22 Source: CSO Census 2016 Population Aged 15 Years and Over at Work 2011 to 2016 by Detailed Occupational Group and Broad Industry Group.
23 This will need to be researched further in this study.
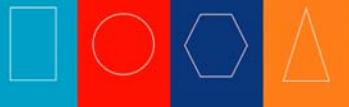
number issued in 2015. A breakdown of ICT Practitioner roles for which employment permits were issued in 2016 is given in Figure 5.

EU Eurostat information on ICT Practitioners in Europe as a percentage of total employment in each country for 2015 indicated that Ireland is ranked 8th out of EU 28 countries. Ireland ranked below comparator countries such as Finland and Sweden, UK, Netherlands Estonia and Belgium.

These indicators point to demand for ICT Practitioner skills in Ireland growing stronger. Meanwhile, a continuing strong demand for ICT Practitioners across Europe is also forecast. Ireland is in intense competition with other countries, both to retain domestic talent and to attract ICT Practitioners from abroad- including expatriate talent (Ireland established the TechLife Portal in June 2016 to attract more ICT talent from abroad).

Against this background, it is essential that a new forecast for ICT Practitioner skills demand in Ireland is undertaken, so that through an updated ICT Skills Action Plan the necessary measures can be put in place to ensure the required supply. If skills supply constraints are not addressed this may lead to the higher growth rate not being sustained.

**Figure 1: Trend in ICT Practitioner Employment in Ireland 2011- 2016**



Source: CSO Census 2016
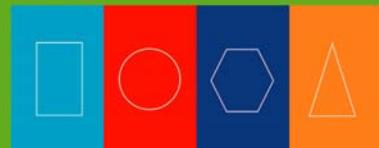
**Figure 2: Trend in ICT Practitioner Employment 2011- 2016 by Occupations**



Trend in ICT Practitioner Employment 2011 - 2016 by Occupation

| | IT & Telecommunications Directors | IT Specialist Managers | IT project & programme Managers | IT business analysts, architects, systems designers | Programmers & Software development | Web design & Development | IT and Telecommunications n.e.c. | IT Engineers | IT operations Technicians | IT user support technicians | Electrical & Electronic Engineers | Design & development Engineers | Telecommunications Engineers | Electrical & Electronics Technicians |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 625 | 7,827 | 4,046 | 3,265 | 13,240 | 1,933 | 5,269 | 2,977 | 6,517 | 4,309 | 6,068 | 2,016 | 5,196 | 2,063 |
| 2016 | 1,715 | 10,661 | 4,330 | 4,187 | 20,113 | 2,257 | 6,601 | 3,764 | 6,750 | 5,477 | 6,724 | 2,674 | 4,193 | 2,150 |

**Figure 3: Annual Growth rate ICT Practitioner Occupations 2011-2016**



Compound Annual Growth Rate ICT Practioner Occupations 2011-2016
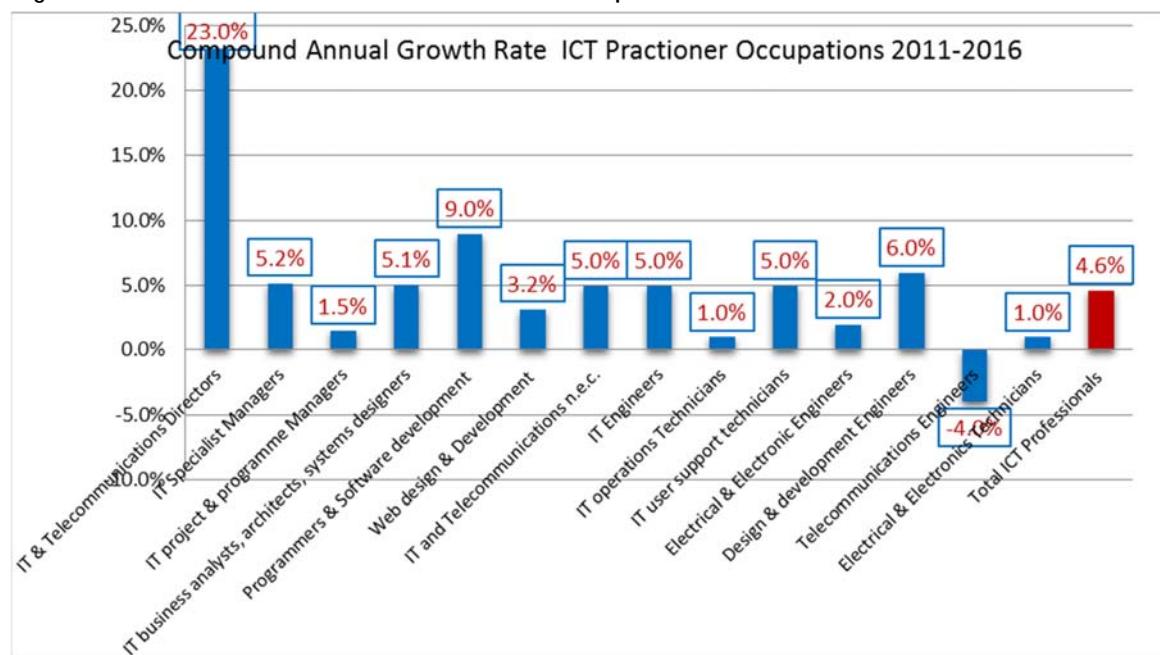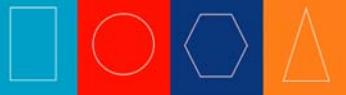
**Figure: 4: ICT Practitioner Employment by Sector 2016 – Ireland**



ICT Practitioner Employment in Ireland by Sector 2016
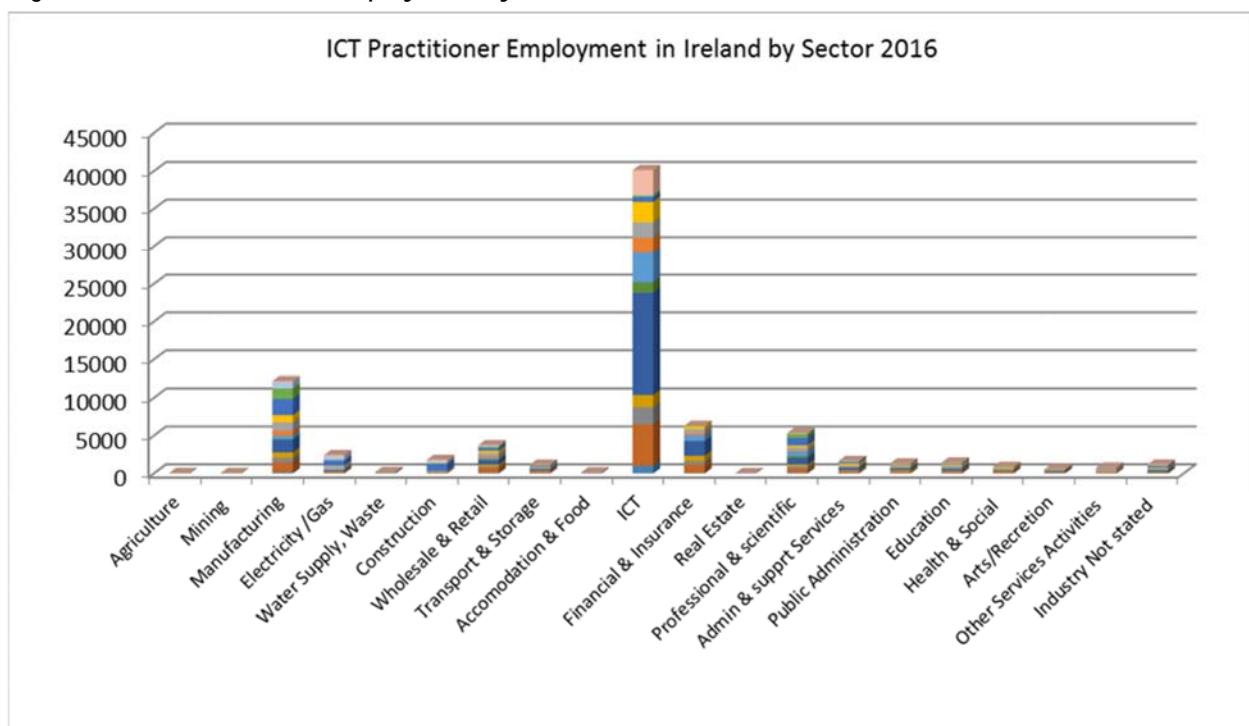
**Figure 5: Breakdown of Roles – ICT Practitioner Employment Permits Issued 2016 – Ireland**
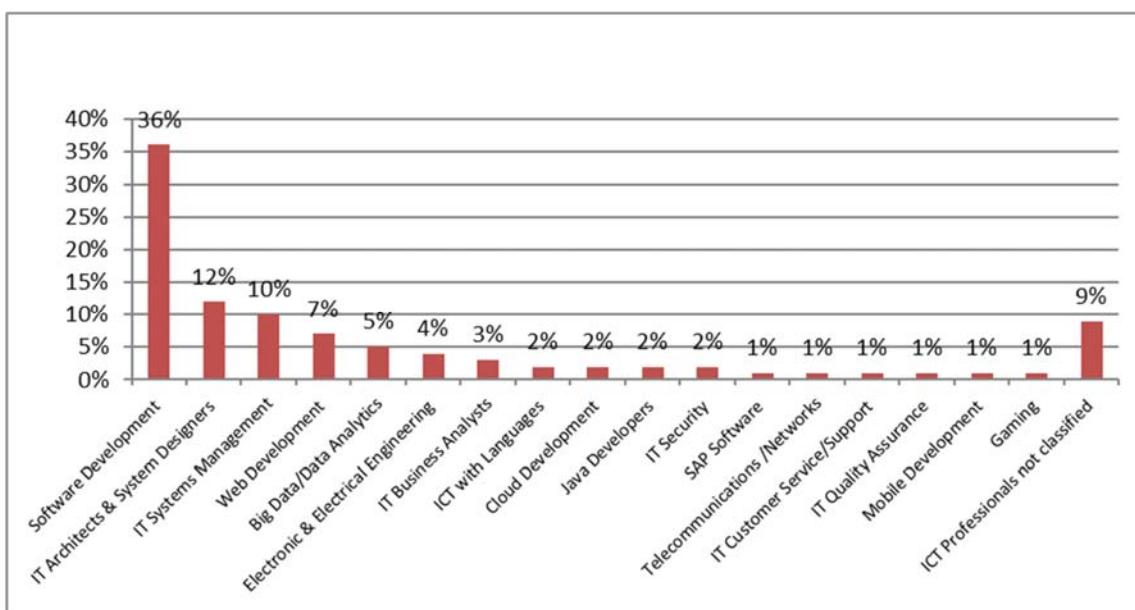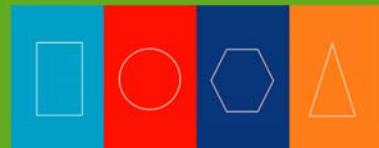
**Methodology**

**ICT Practitioners Demand Forecast Exercise**

This element of the Study will present three plausible demand scenarios for ICT Practitioners skills arising within (i) the ICT sector and (ii) across other sectors of the economy, over the period 2017-2022.

Each scenario will depict credible forecasts based on key drivers and trends and derived in a logical and deductive way. There will be one central scenario that is anticipated most likely to occur. The baseline for each scenario will be the level of demand in 2016 (derived from the CSO Census 2016). Each scenario will forecast the annual demand for ICT Practitioners (by NFQ levels 6/7 and levels 8/9/10) broken down by expansion demand and replacement demand for people with the following skills:

- Computing engineering skills (including computing software engineering and computer programming and multi-media gaming with a substantial computing content), and;
- Electronic & electrical engineering skills (including communications and mechatronics and electronic/computing engineering).

The analysis will also encompass roles of a comparable level requiring a mix of technical and business/analytic/foreign language skills. The development of the demand forecast scenarios will be based on a mapping of the main international trends and key drivers of change impacting on the level and nature of skill demand.

The project adopts an EU Eurostat occupational definition of an ICT Practitioner which includes the capabilities required for researching, developing, designing, strategic planning, managing, producing, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems[24]. The study will not include people with primarily ICT user skills[25].

The baseline employment figures for ICT Practitioners will be derived from the CSO Census 2016 results in relation to the following SOC 2010 occupational codes.

Computing skills:

- Information technology and telecommunications directors - Code 1136
- IT specialist managers - Code 2133
- IT project and programme managers - Code 2134
- IT business analysts, architects and systems designers - Code 2135
- Programmers and software development professionals - Code 2136
- Web design and development professionals - Code 2137

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24 http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:E-skills.
25 ICT user skills are the capabilities required for the effective application of ICT systems and devices by the individuals as tools in support of their own work and the use of common software tools and of specialised tools supporting business functions within industry. At the general level, they cover "digital literacy".
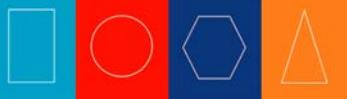
- IT and telecommunications professionals not elsewhere included - Code 2139
- IT operations technicians - Code 3131
- IT user support technicians - Code 3132
- IT engineers - Code 5245

Electronic & Electrical Engineering:
- Electrical and electronic engineers - Codes 2123 and 2124
- Design and development engineers - Code 2126
- Electrical and electronics technicians - Code 3112
- Telecommunications engineers - Code 5242

**The Qualitative Research Exercise**

The qualitative exercise will inform the shaping of the ICT Practitioner demand forecast scenarios and identify emerging skillsets and competency requirements for ICT Practitioners. The exercise will consider the nature of the demand for ICT Practitioner at (i) NFQ levels 6&7 and at (ii) NFQ Levels 8/9/10. The qualitative research exercise will comprise:

- Structured Interview surveys by telephone with approx. 40 enterprises selected from across different sectors of the economy that employ a high percentage of ICT Practitioner staff.

- Structured Interview surveys (by meeting/or telephone) with twenty key informants.

- Discussions with selected companies and key informants in at least two workshops- one to be held in Dublin and one in Cork.

This part of the exercise will also elicit ideas or recommendations from stakeholders on how to boost the quantity, quality and diversity of ICT Practitioner skillsets and competences in Ireland, over and above those currently pertaining.

**Outputs Expected**

The expected outputs for this study will be the following:

A report with an executive summary (60-70 pages- excluding appendices), presenting the following:

1   Annual demand scenario forecasts for ICT Practitioner skills broken down for (a) Computer engineering; and (b) Electronic and Electrical Engineering, by NFQ Levels 6-10 within (i) the ICT sector and (ii) other sectors of the economy, over the period 2017-2022. There will be one Central skills demand forecast anticipated as most likely to occur.
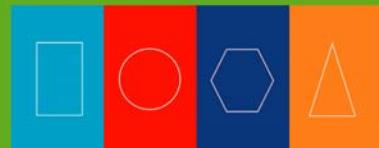
2    The implications of the central skill demand forecast scenario for emerging skillsets and competences for computing engineering and electronic/electrical engineering occupations (including roles requiring a mix of comparable technical and business/analytics/foreign language skills)

3    An overview of ideas and recommendations elicited from stakeholders on how to boost the quantity, quality and diversity of ICT Practitioner skillsets and competences in Ireland, over and above those currently pertaining

**Expected Project Time Line**

The Project will commence in early October 2017, with the final report to be completed by late-February 2018.

**Project Steering Group**

A Project Steering Group, composed of ICT Skills Stakeholders from Government and the private sector, will oversee the exercise. The main role of members of the Steering Group will include contributing their ideas/valuable expertise on:

- The shaping up of the project at its early stage; and
- Ensuring the successful progress of the work of the project
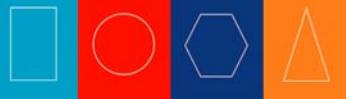
# Appendix II: Members of the Steering Group

| Paul Sweetman (Chairperson) | Technology Ireland |
|---|---|
| Trudy Duffy | Department of Education and Skills |
| Paul Keating | Department of Education and Skills |
| Barry Lowry | Office of the Government Chief Information Office |
| Alan McGrath | Higher Education Authority |
| Dr Selen Guerin | Skills and Labour Market Research Unit, SOLAS |
| Caroline Shally | Skills and Labour Market Research Unit, SOLAS |
| Helen McMahon | Enterprise Ireland |
| John McNamara | Enterprise Ireland |
| Leo Clancy | IDA Ireland |
| Siobhan O' Shea | CPL Resources |
| Dr Richard Manton | Engineers Ireland |
| Peter Davitt | Fastrack into IT |
| Mary Cleary | Irish Computer Society/Digital Jobs and Skills Coalition |
| Leonard Hobbs | MIDAS |
| Liam Ryan | SAP |
| Denis English | Version 1 |
| Kevin Daly | Department of Business, Enterprise and Innovation |
| Dr Alan Power (Project Manager) | Department of Business, Enterprise and Innovation |
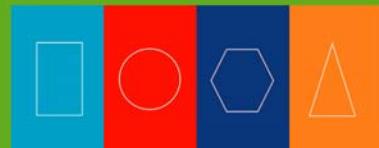
# Appendix III: Members of the Expert Group on Future Skills Needs

| Tony Donohoe (Chairperson) | Ibec |
|---|---|
| Kevin Daly | Head of Secretariat and Principal Officer, Skills and Education Policy Unit, Department of Business, Enterprise and Innovation |
| David Hegarty | Assistant Secretary, Department of Business, Enterprise and Innovation |
| William Beausang | Assistant Secretary, Department of Education and Skills |
| Kathleen Gavin | Principal Officer, Department of Education and Skills |
| Keelin Fagan | Enterprise Ireland |
| Dr Vivienne Patterson | Higher Education Authority |
| Dr Peter Rigney | Irish Congress of Trade Unions |
| Ray Bowe | IDA Ireland |
| Alan McGrath | SOLAS |
| Dr Selen Guerin | Skills and Labour Market Research Unit, SOLAS |
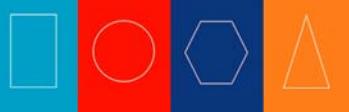
# Appendix IV: Glossary of Terms

AI Artificial Intelligence

BDA Big Data and Analytics

CAD Computer Aided Design

CAGR Compound Annual Growth Rate

CEDEFOP European Centre for the Development of Vocational Training

CEO Chief Executive Officer

CS Cognitive Systems

CSO Central Statistics Office

DLT Distributed Ledger Technologies

DRAM Dynamic Random-Access Memory

EGFSN Expert Group on Future Skills Needs

EI Enterprise Ireland

EU European Union

FDI Foreign Direct Investment

FTE Full Time Equivalent

GDP Gross Domestic Product

GDPR General Data Protection Regulation

GNI* Modified Gross National Income

GPS Global Positioning System

HR Human Resources

ICT Information and Communications Technology

IDC International Data Corporation

IMF International Monetary Fund

IoT Internet of Things

MADPS Mobile Application Development Platforms

MIT Massachusetts Institute of Technology

MNC Multinational Corporation

NFC Nearfield Communication

NFQ National Framework of Qualifications

NISD Network Information Security Directive

P2P Peer to Peer

PC Personal Computer

POC Proofs of Concept

QQI Quality and Qualifications Ireland

R&D Research and Development

RPA Robotic Process Automation
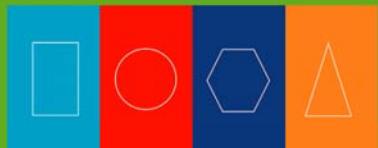
SLM Selective Laser Melting

SLS Selective Laser Sintering

SME Small and Medium Enterprise

SOC Standard Occupational Classification

STAP Specialised threat analysis and protection

STEM Science, Technology, Engineering and Mathematics

SW Software

UEM Unified Endpoint Management

UI User Interface

UX User Experience

# Notes

Expert Group on
**Future Skills Needs**