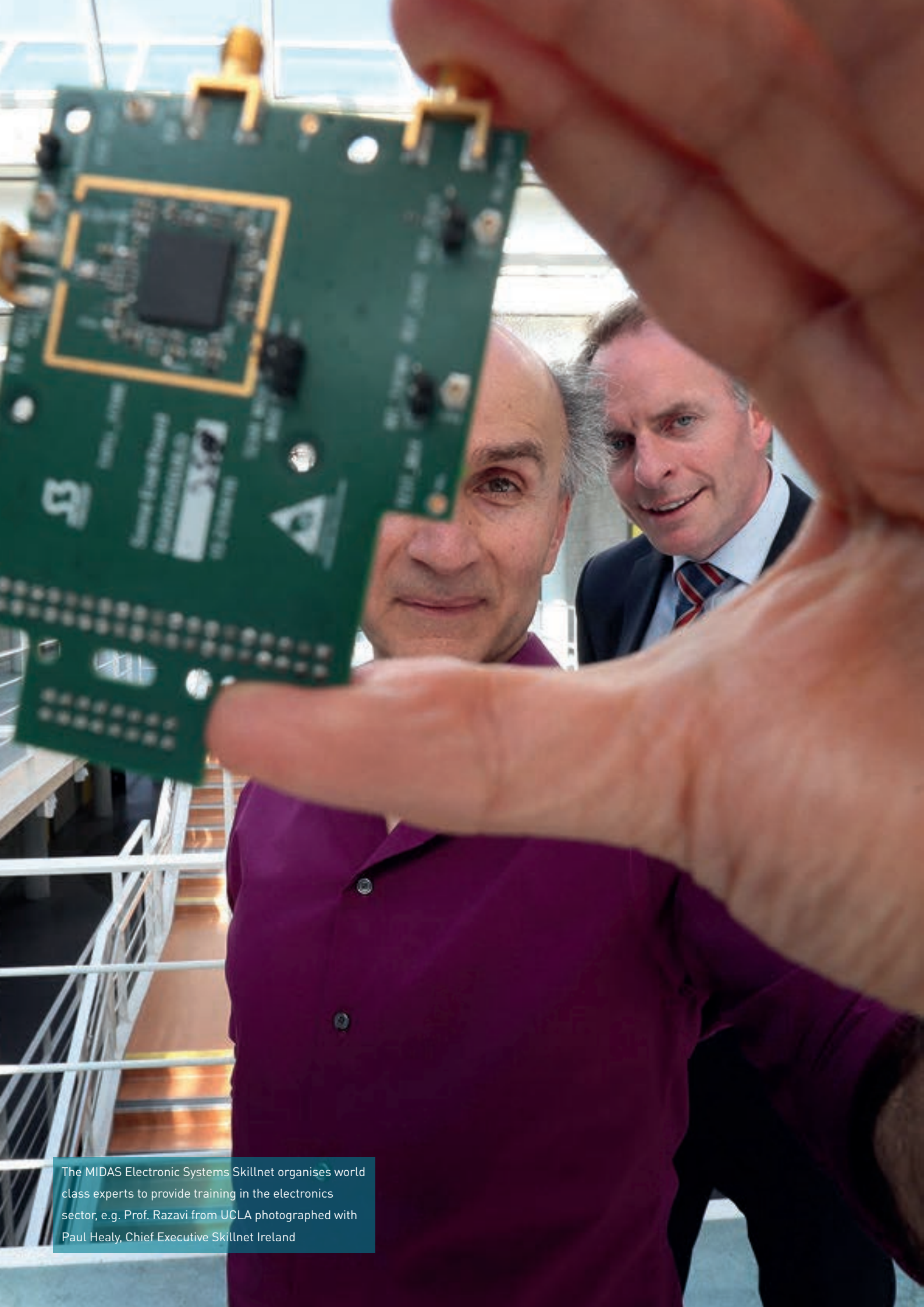
Electronics Sector Resources & Skills Needs

JANUARY 2021

MIDAS Electronic Systems Skillnet

MIDAS IRELAND



The MIDAS Electronic Systems Skillnet organises world class experts to provide training in the electronics sector, e.g. Prof. Razavi from UCLA photographed with Paul Healy, Chief Executive Skillnet Ireland

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MIDAS Ireland regularly recognises outstanding contributions to the electronics sector with its Lifetime Achievement Award, here awarded by Leonard Hobbs to Maurice Whelan founder of S3

Foreword

Foreword

Since the arrival of Analog Devices to Limerick in the 1970's, Ireland has done exceptionally well in attracting leading edge semiconductor enabled companies from the US and further afield. The 80's saw the emergence of the mainframe computer as the primary business driver with Digital Electronics and Amdahl arriving to these shores. The 90's saw the birth of the era of the personal computer and Ireland attracted Intel, HP, Dell and IBM. As the internet emerged in 00's further investment arrived from the so called 'born on the internet' companies such as Facebook, Google and LinkedIn. In the meantime, a vibrant indigenous ecosystem emerged including Silicon Software Systems in 1986, followed by Parthus in 1993 and Movidius in 2005, supported by leading research institutes such as the National Microelectronics Research Centre, founded in 1981, later to be called The Tyndall National Institute. Engineers from Ireland have progressed to global leadership levels within their corporations at Intel, Analog Devices, Dell and Xilinx.

MIDAS Ireland was established in 1999 to meet the needs of the growing ecosystem and to represent not only industry but also academia, research and government agencies, working together to assist in the development of the 'micro and nano-electronics based systems sector' in Ireland. Today we represent 60 companies having expanded our membership by 60% in the last four years.

As the electronics sector continues to evolve and grow globally, so too does it evolve and grow in Ireland. Recent major job announcements from Microchip and Cadence, along with acquisitions of Movidius by Intel and Decawave by Qorvo have shown that this deep tech sector remains a vibrant part of the tech sector in Ireland with 20,000 expert jobs, €13.5bn in export revenue and €450m of R&D spend annually.

The future looks bright for the sector globally, largely driven by the pace of digital transformation across all business sectors and accelerated by the Covid-19 crisis. However the sector is not without its challenges as the availability of talent has the potential to constrain its growth and the need to upskill the existing workforce remains a critical ingredient to future competitiveness. These skills not only include new technology related skills in areas such as machine learning but also what is known as 'soft skills' in areas such as critical thinking, problem solving and resilience. In addition the Covid-19 crisis has posed new challenges and opportunities from a future of work perspective with a recent report from the World Economic Forum[1] predicting that *"a significant share of companies also expect to make changes to locations, their value chains, and the size of their workforce due to factors beyond technology in the next five years"*

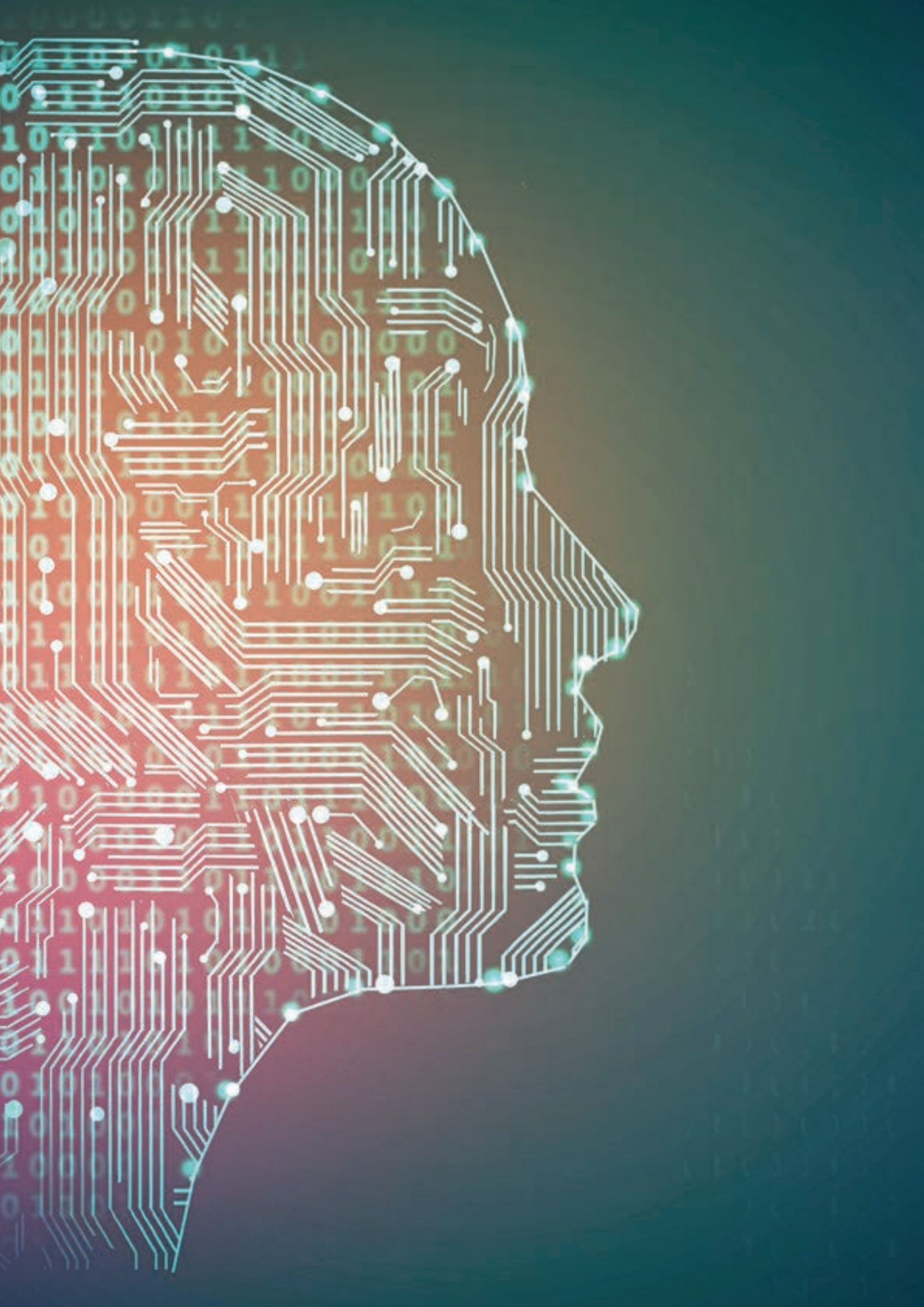
1 World Economic Forum, The Future of Jobs Report 2020, October 2020

As such we welcome this report and would acknowledge the excellent work done by its author and electronics sector veteran, John Blake. We would like to thank all those who have contributed and in particular Skillnet Ireland for approving funding to facilitate this initiative. We look forward to working with our member companies and other stakeholders in implementing its recommendations in the weeks and months ahead.

Leonard Hobbs
General Manager
MIDAS Ireland

John Quill
Director and Secretary
MIDAS Ireland

MIDAS Annual Conference 2019



chapter **ONE**

Executive Summary

Executive Summary

This project was commissioned by MIDAS Ireland and the MIDAS Electronic Systems Skillnet and funded by Skillnet Ireland.

The purpose of this report is to set out the findings from a research study into the Irish electronics sector future resource and skills needs for the MIDAS Electronic Systems Skillnet and its member companies.

While a shortage of resources and skills gaps are constantly recurring themes in the electronics sector, a detailed survey and study of precisely which specific areas and skills are most urgently required has never been undertaken. While providing the environment to support Irish-based electronic systems SMEs to succeed and at the same time competing on the world stage for foreign direct investment (FDI) into electronics, Ireland needs to demonstrate capability to provide electronic engineering resources with highly specialised skillsets and to maintain these skills at the ever-evolving cutting edge of technology.

> *"The Microelectronics sector has been an important one for Ireland since the 1970s and has grown to be a large industry in Ireland, spanning manufacturing, design and many activities within global supply chains and having high impact in economic and human capital terms. This is an industry that continues to grow and evolve globally and that demands excellence at all levels in the skill base that supports it. Whether in design or manufacturing, the work requires incredibly skilled and precise engineering capabilities and the complexity continues to increase. In this context, a clear examination of industry needs that will lead to proposals to increase the applicable graduate base, the skill levels of those already employed and the potential for workforce expansion is very welcome. This is a long-term industry with excellent jobs and high economic impact and such specific needs that they merit specific investigation"*
>
> **Leo Clancy, Head of Technology, Consumer and Business Services, IDA Ireland**

> *"Enterprise Ireland welcomes this valuable report which highlights the essential skills needs for the future development of the Electronics sector in Ireland. The Electronics sector is an important sector within the Enterprise Ireland client base for many decades. The sector has proven resilient, has adapted to many challenges in the past and has been growing strongly in recent years accessing opportunities in existing and emerging growth markets.*
>
> *This is an industry sector that has responded and developed to meet key Global technology trends such as; Industry 4.0, the development of Connected, Autonomous, Shared, Electric (CASE) technologies in automotive, the emergence of healthcare devices to support assisted living and remote monitoring; the growth in Photonics and the Aerospace and the Space sectors. The Irish electronics sector has a strong highly skilled employment base in design, development and manufacturing.*
>
> *Future workforce demographics and changing skills needs will require the development of highly trained graduates & apprentices, to address the upskilling of current employees and expansion of the workforce to support the growth of the sector.*
>
> *The report identifies the specific areas and skills which are most urgently required by the Electronics sector over the coming years to deliver on growth opportunities. This will require skills in sensor technology, communications technologies, data analytics & software. Notwithstanding the impact of Covid-19, the report highlights how the sector has growth potential, a growing demand for its services and a requirement to increase the pool of skills over the coming years. This will support the aim to grow this internationally focused sector with globally attractive capabilities while also supporting the creation of high value sustainable employment."*
>
> **Carol Gibbons, Divisional Manager ICT & International Traded Services, Enterprise Ireland**

During the project, data was collected from almost 70 companies within the electronics sector with a specific focus on companies carrying out R&D activities in Ireland. These companies range from some of the world leaders in the sector to small Irish based SMEs. A small number of companies are doing state-of-the-

art semiconductor manufacturing, with a large number doing advanced Integrated Circuit (IC) design and product development, several others are doing electronic system design and some are providing services and contracting. Some of the companies are active in more than one of these areas.

The sector in Ireland is close to 50 years old with the first companies starting operations here during the 1970's. There has been steady growth in employment and the number of companies over the subsequent decades, and this growth is particularly evident during the most recent decade.

Today, the range and quality of the R&D in Ireland is on a par with anywhere in the world. This is evidenced by the types of products and services being developed by the various companies and in the case of the multi-nationals the key roles that the Irish based R&D teams play in their overall world-wide operations. There have been several success stories among the SME community, with a few of these acquired recently for very significant sums of money.

From the survey carried out as part of this project, it is estimated that there are currently about 3,000 engineers working in highly skilled R&D jobs within the electronics sector in Ireland. At an average fully loaded engineering cost of about €150k per R&D position, this adds up to a total business expenditure on R&D (BERD) in the €400M to €500M range for the whole sector.[2]

Hence the electronics sector is important to the Irish economy and merits the support it needs.

While this project was commissioned by MIDAS Ireland and the MIDAS Electronic Systems Skillnet, several interested stakeholders were consulted on the project plan, and reported back to during the project and at its conclusion. The stakeholders included the MIDAS Electronics Systems Skillnet Manager and Steering Group, The MIDAS Ireland General Manager, Directors and Industry Advisory Group, IDA Ireland and Enterprise Ireland.

The report's findings, recommendations and action plan have been informed by an industry wide survey sent to about 130 leaders at almost 70 companies across the electronics sector in Ireland. The survey findings were discussed in more detail in a series of one-on-one interviews with a sample the survey respondents. Over 20 interviews took place, mostly over the phone, due to the social distancing constraints resulting from the Covid-19 pandemic. Arising out of the survey and interviews, a draft list of proposed recommendations was put together.

A series of meetings was held with educators and trainers to discuss how to implement the proposed recommendations from industry, and to identify any potential obstacles / challenges that exist and discuss how these might be overcome.

The following is a high level summary of the findings from the project.

Findings 1: Staff Numbers

1a. There are a total of about 12,000 people employed in the Irish electronics sector included within the scope of this project.

1b. Over 50% of the jobs are in highly skilled technical roles, with about 3,000 of these in world-class research and development (R&D).

1c. During the past 3 years, over 900 people have been hired into R&D positions, with over a third of these college graduates at a rate of over 100 per year.

1d. Predictions are for the rate of hiring to increase during the next few years.

1e. Approximately one third of the hiring is from outside Ireland, with about an equal split of these hires between other countries in Europe and the rest of the world.

1f. During recent years there has been an increase in hiring into software, applications and systems roles, although hiring into the traditional IC design related roles is also growing.

2 MIDAS Brochure

Findings 2: Trends

2a. The vast majority of survey respondents expect that future hiring will increase.

2b. Most survey respondents say that future skills will need to improve.

2c. The top trends expected to affect the electronics sector during the next few years are:
- (i) Environment / Climate Change / Energy Conservation.
- (ii) Data Analytics / Artificial Intelligence / Machine Learning.
- (iii) Automotive – Electric Vehicles, Autonomous Driving.
- (iv) Healthcare.
- (v) How we live and work (e.g. remote working will increase).

2d. These trends are expected to influence future sector skills in the following areas:
- (i) Increased demand for low power design techniques.
- (ii) Data Analytics, etc, are mostly new skills needed by the electronics sector.
- (iii) Automotive demands more rigorous, structured and better documented design and product development flows.
- (iv) Future healthcare will require a system approach to electronic product development including everything from sensors to circuits, communications, data analysis and software.
- (v) Future working arrangements will drive a need for improved soft skills.

Findings 3: Industry Training provided by MIDAS Electronics Systems Skillnet

3a. Strong interest in short training courses and a desire to have expert trainers.

3b. Significant interest in CPD Modules, with Level 9 (Masters) being the desired standard and part-time being the preferred approach.

3c. The following were the primary areas suggested for future development of new CPD Modules.
- (i) Design Verification.
- (ii) IC Design (various topics).
- (iii) Software (various topics).
- (iv) Data Analytics / Artificial Intelligence / Machine Learning.
- (v) Business / Entrepreneurship.

3d. The majority of survey respondents say that Soft Skills will need to improve in future.

Findings 4: Graduate Education

4a. Most survey respondents believe that graduate skills will need to improve in future.

4b. The following were the primary areas for suggested for subject knowledge improvement for future graduates.
- (i) IC Design (Various Topics).
- (ii) Software (Coding, Firmware, Python, etc).
- (iii) Soft Skills.
- (iv) Systems (Various Topics).
- (v) Data Analytics / Artificial Intelligence / Machine Learning / Mathematics.

4c. Work placements / internships and industry relevant project work are critical components that need to be part of a graduate's learning experience and built on top of the theory learned in the classroom.

4d. Survey respondents said that future graduate hiring will demand an increased percentage of graduates educated to Level 9 and Level 10 standard than is the case today.

4e. There is a significant demand for more suitably qualified Level 7 (Technician) graduates than are working in the electronics sector today.

4f. The survey suggested that graduates' perception of the electronics sector as a place in which to build their career is not as positive as it needs to be.

Findings 5: International

5a. Survey respondents said they believe the skillsets of engineers in Ireland is similar to what they have seen in other countries.

5b. The following were some suggestions on areas that Ireland can learn from what survey respondents have seen in other countries.
- (i) Graduate internship and apprenticeships are commonly used.
- (ii) There is significant ongoing CPD within companies along with extensive use of industry training courses.
- (iii) Graduate educational content is often broader and deeper.
- (iv) A longer college education to 5 years / Level 9 standard is common, and engineering as a profession has a higher status.
- (v) Academia / industry collaboration on research and work assignments.

5c. About 50% of companies that responded to the survey said that they have opened R&D centres in other countries due to resource shortages in Ireland. It is estimated from the survey responses that over 1,000 highly skilled R&D jobs have been lost to the electronics sector in Ireland for this reason.

Findings 6: New Skills for the Electronics Sector

6a. Survey respondents suggested that new skills are needed as follows:
- (i) Skills that can be used immediately with minimal re-training.
  - (a) Software.
  - (b) Data Analytics / Artificial Intelligence / Machine Learning.
- (ii) Skills that can be used with some re-training.
  - (a) Mathematics.
  - (b) Physics.
  - (c) Software.
  - (d) Data Analytics / Artificial Intelligence / Machine Learning.

6b. Survey respondents said that about 15% of future sector hiring should be for people with these new skills.

The report lists a total of nine recommendations which arose from the various findings. These recommendations are for MIDAS Ireland and the MIDAS Electronics Systems Skillnet, along with the Irish electronics sector, to implement. These are explained in detail in this report along with a proposed action plan to support each recommendation.

The following is a high level summary of the recommendations, which are across four categories aligned with the overall goals of the project. Category 1 aligns with the skills needs, categories 2 and 3 align with the resource needs, and category 4 is on the sector image which is deemed critically important and needed to support the other categories.

Category 1:
Skills / Training

1a. Continue to offer Short Training Courses in support of the needs of the Companies.

1b. Develop new CPD Modules in support of the needs of the Companies.

Explore how a path to a formal Educational Qualification (e.g. Masters) can be put in place.

1c. Develop a plan for and put in place Soft Skills Training for the Electronics Sector Employees.

Category 2:
Resources - Graduates

2a. Put in place a process with the Irish Colleges to discuss course content and optimum learning styles to support the Electronics Sector's future needs.

Investigate if an apprenticeship programme can be put in place to help increase the supply of Level 7's (Technicians).

The ultimate goal is to increase the pool of graduates available to the sector for hiring at the various educational levels.

2b. Companies to engage with colleges on and improve support for Work Placements and Industry Relevant Project Work aligned with future skill needs and with optimum Graduate Learning Styles.

2c. Step up Student Outreach and Engagement to build the brand of the Irish Electronics Sector with Students as an attractive sector in which to build their career.

Category 3:
Resources – Increase the Talent Pool

3a. Develop a plan on how to attract engineers with New Skills to work in the Electronics Sector.

These engineers may already have the necessary skills (e.g. software engineers, data analytics) or need some re-training (e.g. physics, mathematics).

Put the required CPD and re-training initiatives in place to support this process.

3b. Increase hiring into Ireland from abroad (currently at ~35%) to grow the available talent pool and minimize loss of R&D positions to other countries.

Put support in place to assist people with the logistical challenges of moving, and for companies to make the process easier.

Category 4:
Sector Image

4. Promote the Electronics Sector as a great place for people to build their career.

This includes promoting Engineering as a Profession, Electronics' positive contribution to society's needs, as well as highlighting the financial attractiveness of the sector.

chapter **TWO**

Methodology

Methodology

While this project was commissioned by MIDAS Ireland and the MIDAS Electronic Systems Skillnet, several interested stakeholders were consulted on the project plan, and reported back to during the project and at its conclusion. The stakeholders included the MIDAS Electronics Systems Skillnet Manager and Steering Group, The MIDAS Ireland General Manager, Directors and Industry Advisory Group, IDA Ireland and Enterprise Ireland.

A detailed survey, with questions relating to various aspects of the resource and skills needs of the Irish electronics sector, was developed during these stakeholder discussions. The survey went out to 68 companies across the sector. These included MIDAS members, some companies suggested by Enterprise Ireland and some suggested by the MIDAS Electronic Systems Skillnet. See Appendix 1 for the list of companies included in the survey.

The survey went to senior leaders and engineering leaders, along with some human resource and training managers. In total, the survey was sent to about 130 leaders representing the various companies.

Once the survey was completed the results were analysed and some possible actions were noted arising from the responses to each survey question. The actions arising from all the questions were then put together and grouped. Similar actions were combined, some others fine-tuned, a small number put aside, etc, to produce an initial draft of proposed recommendations.

A presentation was then put together that summarised the findings along with the proposed.

The survey findings and proposed recommendations were then discussed in more detail in a series of one-on-one interviews with a sample of the survey respondents. Discussions took place with more than 20 leaders, from across 17 companies with a good mixture of MNCs and SMEs. The interviews were mostly held virtually due to the social distancing constraints resulting from the Covid-19 pandemic.

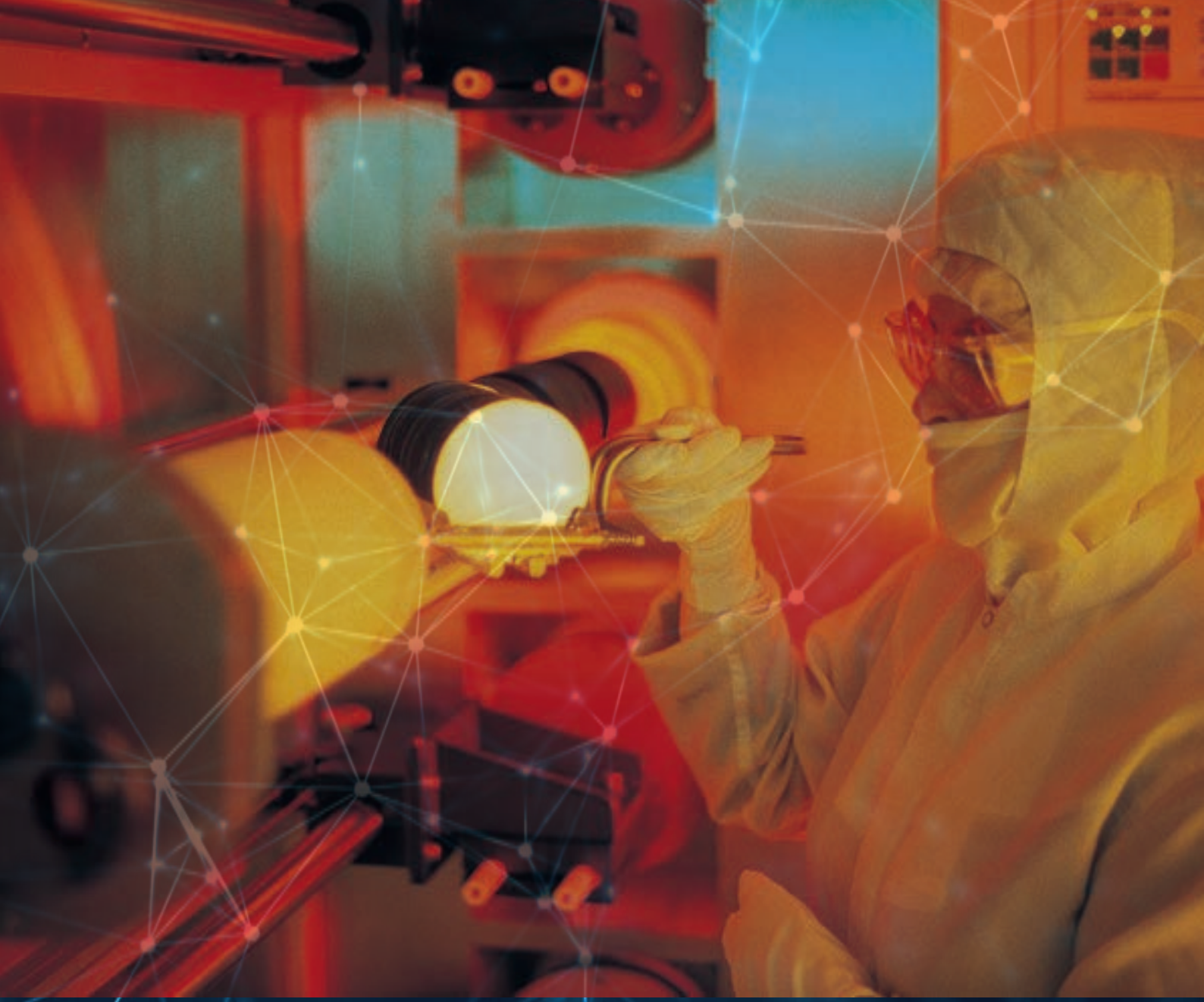
The draft recommendations were also used in discussions with various stakeholders.

Arising from these interviews and discussions some further combining and fine-tuning of the recommendations took place with a final set of recommendations produced.

A series of meetings was then held with educators and trainers to discuss how to implement the proposed recommendations from industry, and to identify any potential obstacles / challenges that exist and discuss how these might be overcome.

A detailed action plan based on all the various discussions, to support each of the proposed recommendations, was also put together.

Collaboration for training purposes has facilitated world class training for employees of all companies in the electronics sector in Ireland as for this Radio Frequency Circuit Design class held in UCD.



chapter **THREE**

Survey and Interview Findings

Survey and Interview Findings

Findings 1:
Staff Numbers

The survey went out to 68 companies across the electronics sector in Ireland. These included MIDAS members, some companies suggested by Enterprise Ireland and some suggested by the MIDAS Electronic Systems Skillnet. See Appendix 1 for the list of companies included in the survey.

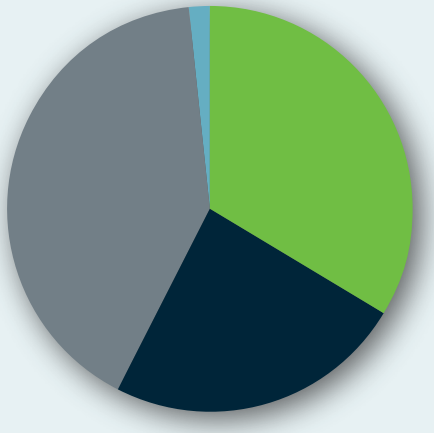
FIGURE 1 ▸ TYPE OF COMPANIES

MNC	23	34%
SME	45	66%
TOTAL	68	

Figure 1 shows the breakdown of the companies (Multinational versus SME) included in the survey.

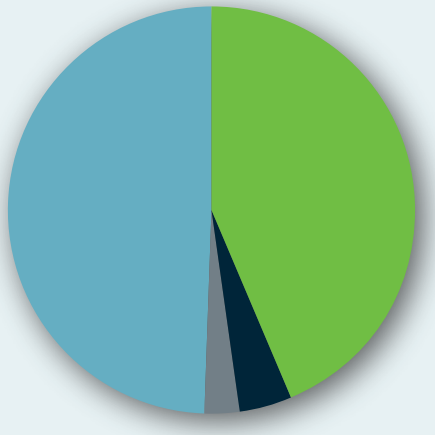
Figures 2 and 3 show how many respondents there were by company type (MNC with >50 employees in Ireland, MNC with <= 50 employees in Ireland and SME) and the roles within those companies for the respondents (Senior Leaders / "C" Level, HR Managers, Training Managers and Engineering Leaders).

FIGURE 2 ▸ RESPONSE BY COMPANY TYPE



MNC>50	24	34%
MCC<=50	17	24%
SME	29	41%
OTHER	1	1%
TOTAL	71	

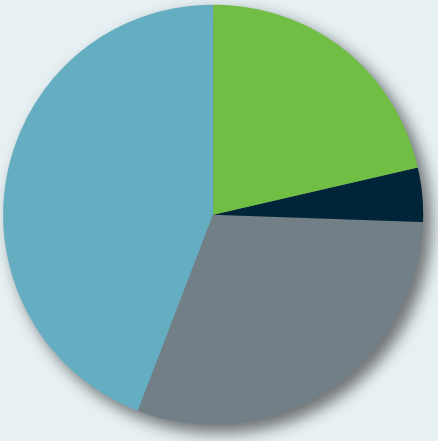
FIGURE 3 ▸ RESPONDER BY COMPANY ROLE



C LEVEL	31	44%
HR	3	4%
TRAINING	2	3%
ENG LEAD	35	49%
TOTAL	71	

In total, there are almost 12,000 people working in the electronics sector in Ireland included within the scope of this project, with about 6,600 or 56% in highly skilled engineering roles, which are split about equally between R&D and technical support for state-of-the-art semiconductor manufacturing. The total R&D staff count is about 3,000 with about an 84% / 16% split between MNC versus SME.

FIGURE 4 ▸ SECTOR EMPLOYMENT



R&D MNC	2,538	21%
R&D SME	486	4%
Mfg Tech	3,605	31%
Other	5,188	44%
TOTAL R&D	**3,024**	**26%**
TOTAL EMP	**11,817**	

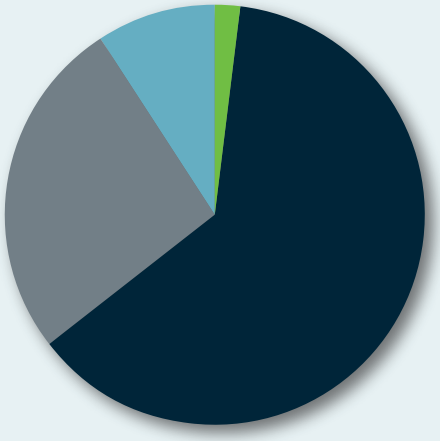
The R&D workforce is very much male dominated with about six male engineers for every female.

FIGURE 5 ▸ GENDER SPLIT

Male	86%
Female	14%

The existing R&D workforce is almost two thirds qualified to Level 8 (Bachelors), with about one quarter to Level 9 (Masters) and about one in ten to Level 10 (PhD). There are very few Level 7s (Technicians) in the existing workforce.

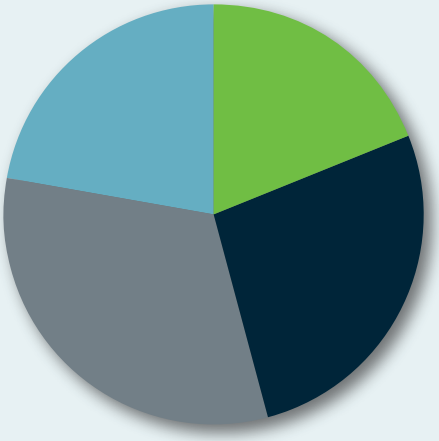
FIGURE 6 ▸ EDUCATION LEVEL



LEVEL 7	2%	LEVEL 9	26%
LEVEL 8	62%	LEVEL 10	9%

In terms of industrial experience, about one in five are recent graduates, about one quarter with three to ten years of experience, about one third with ten to twenty years of experience and about one fifth with longer. This profile suggests a significant volume of recent graduate hiring and that once joining the industry people tend to stay and build their careers there.

FIGURE 7 ▸ YEARS OF EXPERIENCE



<3 YEARS	19%	10 TO 10 YEARS	32%
3 TO 10 YEARS	27%	>20 YEARS	22%

During the past three years (2017 – 2019), companies that responded to the survey said they hired a total of 843 engineers with combined projections to hire 949 during the next three years. This equates to a rise of about 4% per annum. Note that these numbers are just for those companies that answered these questions in the survey.

The data was split out by experienced hires versus graduates hired directly from college. There were a few individual data points that were outliers and skewed the percentage split between graduate versus experienced hires, but analysing the overall data, graduate hiring is about one third of the total, and at a rate of approximately 100 graduates per year into the sector (or a little higher if graduates from the companies that didn't provide this data are taken into account).

FIGURE 8 ▸ RECENT HIRING 2017 - 2019

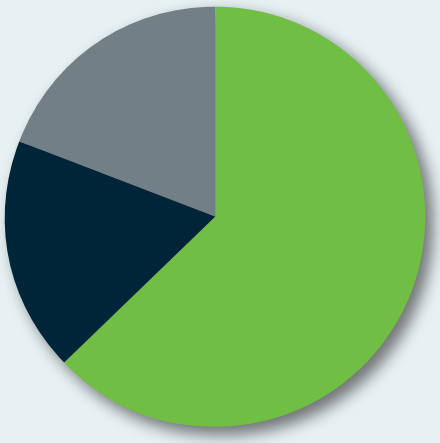
Graduates	337	40%
Experienced	506	60%
TOTAL	843	

FIGURE 9 ▸ HIRING PROJECTION 2021 - 2023

Graduates	290	31%
Experienced	659	69%
TOTAL	949	

Almost two thirds of the recent hiring is from Ireland, either graduates hired directly from college or experienced hires from within the electronics sector in Ireland. Just over one third of the hiring is from outside Ireland, with about an equal split between other European countries and the rest of the world.

FIGURE 10 ▸ SOURCE OF HIRING



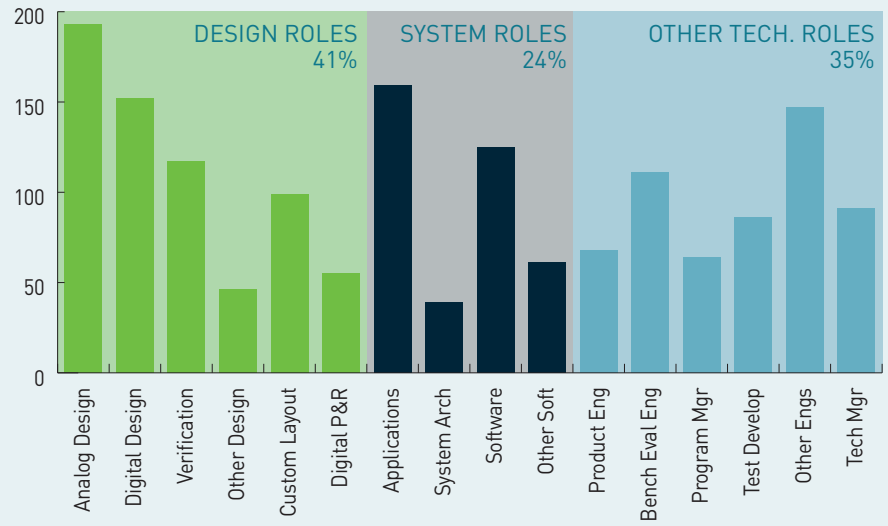
IRELAND	63%
EUROPE	18%
ELSEWHERE	19%

Figure 11 The chart below shows the distribution of the existing R&D workforce across the various engineering roles. It should be noted however that not all companies provided this information, so only a little over 50% of the R&D positions are captured. It is maybe reasonable to "double" the numbers to extrapolate to the full population, but caution should be exercised that the distribution of roles for those companies that didn't respond may be a little different to those that did.

It can be seen from a grouping of these roles that the 'Design' related roles comprise 41% of the total, the 'System' type roles comprise 24% and the 'Other' technical roles make up the remaining 35%.

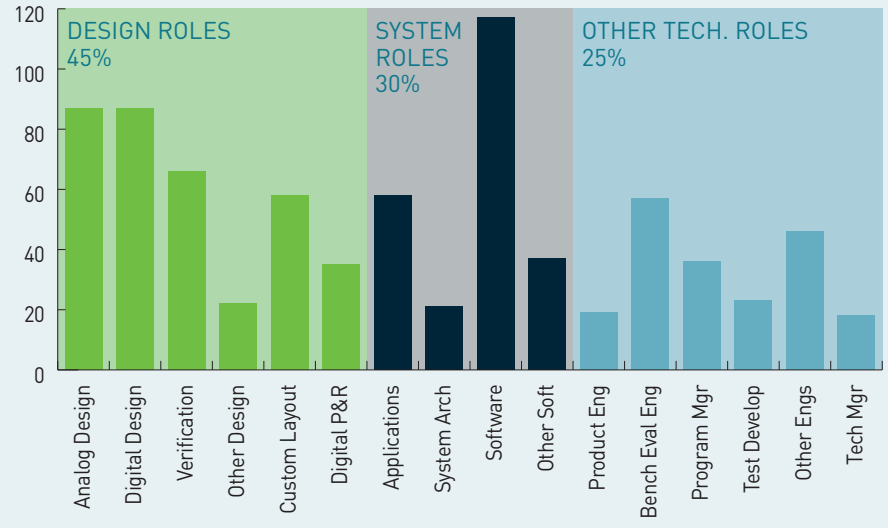
Figure 12 shows the distribution of the recent hiring across the various engineering roles. More companies provided this data than was the case for their overall R&D workforce, so it is believed that 80% to 90% of the overall hiring was captured. Consequently the datasets are not a 100% direct comparison, but close enough that some observations can be made with some caveats. Another notable point here that is significant is that

FIGURE 11 ▸ ENGINEERING ROLES - ALL R&D



DESIGN ROLES	Analog Design	193	12%
	Digital Design	152	9%
	Verification	117	7%
	Other Design	46	3%
	Custom Layout	99	6%
	Digital P&R	55	3%
SYSTEM ROLES	Applications	159	10%
	System Arch	39	2%
	Software	125	8%
	Other Soft	61	4%
OTHER TECH. ROLES	Product Eng	68	4%
	Bench Eval Eng	111	7%
	Program Mgr	64	4%
	Test Develop	86	5%
	Other Engs	147	9%
	Tech Mgr	91	6%
	Total	1611	100%

FIGURE 12 ▸ RECENT HIRING (2017-2019)



DESIGN ROLES	Analog Design	87	11%
	Digital Design	87	11%
	Verification	66	8%
	Other Design	22	3%
	Custom Layout	58	7%
	Digital P&R	35	4%
SYSTEM ROLES	Applications	58	7%
	System Arch	21	3%
	Software	117	15%
	Other Soft	35	5%
OTHER TECH. ROLES	Product Eng	19	2%
	Bench Eval Eng	57	7%
	Program Mgr	36	5%
	Test Develop	23	3%
	Other Engs	46	6%
	Tech Mgr	18	2%
	Total	786	100%

some new applications roles were filled by internal applicants, so the data set below will capture the hiring in a different role. For that reason, it is believed the Applications number for recent hiring is understated.

It can be seen from a grouping of these roles that the 'Design' related roles comprise 45% of the total, the 'System' type roles comprise 30% and the 'Other' technical roles make up the remaining 25%.

Some observations from the data are as follows:

1) Hiring into the various 'IC Design' roles is up and there seems to be a shift towards Digital Design, Verification and P&R. There is also an increase in Custom Layout and it is believed that this is explained by the increase in complexity associated with advanced semiconductor process nodes.

2) There is a significant increase in the 'System' roles. This can be attributed to a number of factors, including increased product complexity and moves by companies from providing products only to more system level solutions to their customers. As such demand for people to fill Applications, Systems, Software and Firmware roles has increased. This trend will be developed further later in the findings as the demand for new skills in the sector comes through strongly.

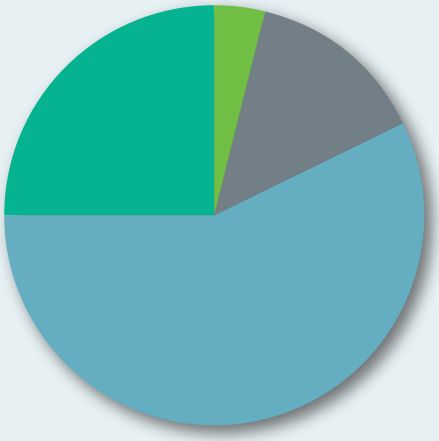
Findings 2:
Future Trends in Electronics

To Question 4 of the survey *(Future trends in electronics will have the effect of increasing hiring needs?)*, more than 80% of respondents either agreed or strongly agreed.

To Question 5 of the survey *(Future trends in electronics will require skill levels (new and / or deeper skills) for engineers to improve in future?)*, about 80% of respondents either said that future skills need to improve a lot or a great deal.

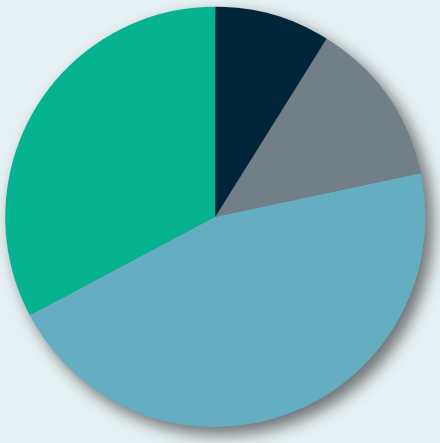
These two responses combined validate that a project like this to understand future resource and skill needs of the electronics sector in Ireland is needed.

FIGURE 13 ▸ FUTURE HIRING WILL INCREASE



Strongly Disagree	4%
Disagree	0%
Neutral	14%
Agree	57%
Strongly Agree	25%

FIGURE 14 ▸ FUTURE SKILLS NEED TO IMPROVE



No	0%
A Little	9%
Moderately	13%
A Lot	46%
A great Deal	33%

Question 3 *(What future trends do you expect to have an influence on the electronics industry during the next 5 to 10 years?)*, Question 4 *(What new skills or skill improvements do you see that will be required by the engineer of the future?)* and Question 5 *(What new training initiatives would you like to see to upskill the engineering workforce in the electronics sector?)* asked about the future trends that are expected to effect the electronics sector and what these trends mean for future skills and associate training.

The following is a summary of the most common themes that were mentioned by respondents.

About 60% of respondents listed a trend in the general area of the environment / climate change / energy conservation. In analysing the responses, a common

theme in terms of skills is the need to improve low power design techniques, which would include low power circuit design, more efficient power delivery and more efficient power management at the system level.

About 60% of respondents listed a trend in the general area of data analytics / artificial intelligence / machine learning. In analysing the responses, there are a wide range of points made and applications for data analytics, both within existing roles, but also as standalone functions. What can be said though is that these are mostly new skills for the sector, which points to a need for the sector to think strategically how new skills sets are brought in.

Almost 50% of respondents listed a trend in the automotive area, which includes electric vehicles and autonomous driving. There are several companies within the sector doing R&D in the automotive space which demands a more rigorous product development flow than is typical for other often more consumer focussed markets. Better documentation is needed as well as tracking of requirements through the development flow from specification to design, verification, product validation and reporting to the customer. Skills applicable to this way of working can be identified.

About 35% of respondents listed a trend in the future healthcare area. In analysing the responses the primary messages were around a system level approach to product development. This includes everything from sensors, to circuits, communications, data analysis and software, in an effort to provide more complete solutions to customers. This approach is also increasingly seen in other applications and is driving new and broader skillsets with engineers needs to understand different aspects of the system spanning both hardware and software, as well as end applications. These are mostly relatively new skills for the sector.

About 35% of respondents listed a trend in the general area of how we will live and work in future. Many of the comments here mentioned 'increased working from home' as a likely future norm. This is likely to require improved soft skills in the areas of communication, remote team working, remote management of people and projects, etc. Engineers are typically known and hired for their advanced technical capabilities, so soft skills can sometimes be ignored, even by management in technical environments.

Other trends that were mentioned by respondents were future advances in communication technologies (4G, 5G, etc), changes in how business is done (M&A, globalisation, digitalisation) and how industry operates (Industry 4.0, automation, smart cities) as well as more general technology advances (quantum computing, Moore's Law, More than Moore). Other new and improved skills will be needed to support these.

Arising from these combined trends and new skills, several areas for training were proposed. The following is a high-level summary:

(i) Software / Firmware
(ii) Soft Skills / Remote Working
(iii) IC Design (Analog, RF, Power, Technology, etc)
(iv) Data Analytics / Artificial Intelligence / Machine Learning
(v) System Level / Applications

The future sector training requirements will be discussed in more depth later in this report.

Findings 3:
Industry Training provided by MIDAS Electronics Systems Skillnet

There were a number of questions in the survey related to industry training, and in particular the training being provided by the MIDAS Electronics Systems Skillnet which has two training strands.

There are short training courses which are typically of two to three days duration where an expert trainer teaches a class of typically 10 – 20 engineers in an area of interest.

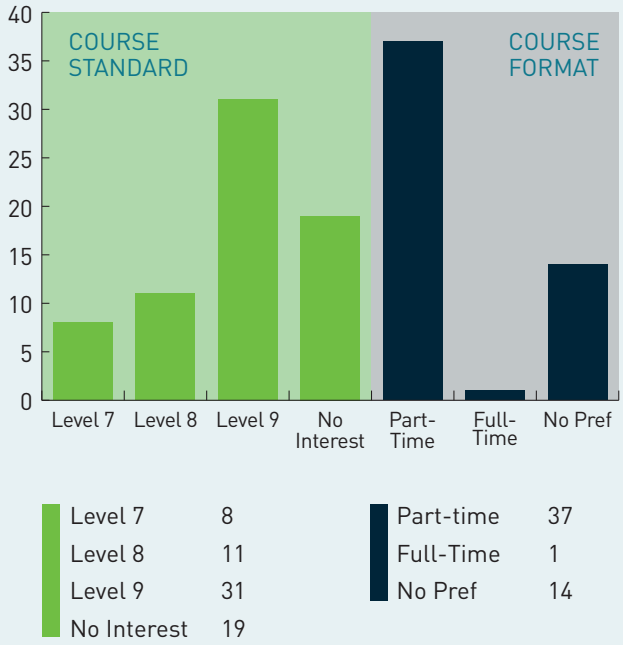
There are also what are called CPD Modules which go deeper into a subject over a 12-week semester with lectures, labs and project work, followed by an examination. The CPD modules are typically taught by a college lecturer who has significant industry experience, so the hands-on practical skills that an engineer needs to do a job in industry are taught. The CPD Modules are accredited to Level 9 (Masters) standard and typically qualify for 5 to 10 Level 9 ECTS Credits.

To Question 8 of the survey *(Rank the types of training and development that you would like to see increased)* respondents expressed a strong interest in short training courses and a smaller, but still significant, interest in the CPD Modules. The CPD Modules are not for everybody, but there is sufficient interest that they should be actively supported.

To Question 9 of the survey *(Rank where would you like to see trainers from)* respondents expressed clear preference to have world-wide experts as trainers. The message here was that the quality of the trainer is very important, while in many cases there are excellent trainers available locally. This point was made in the follow-up leader interviews. Of course, with on-line course delivery becoming the norm during the Covid-19 pandemic, it was also suggested that sourcing expert trainers that are not local has become more feasible.

To Question 14 of the survey the majority of respondents selected Level 9 (Masters) as the correct educational standard for the CPD Modules and they expressed a very strong preference for part-time over full-time for the format. This corresponds to the current approach taken for the first two CPD Modules that have been developed, so it is good that the industry is aligned.

FIGURE 15 ▸ CPD MODULE



To Question 12 *(Are there CPD Modules that you see a future need for?)* of the survey, respondents provided their suggestions. The following is a high-level summary of what was proposed.

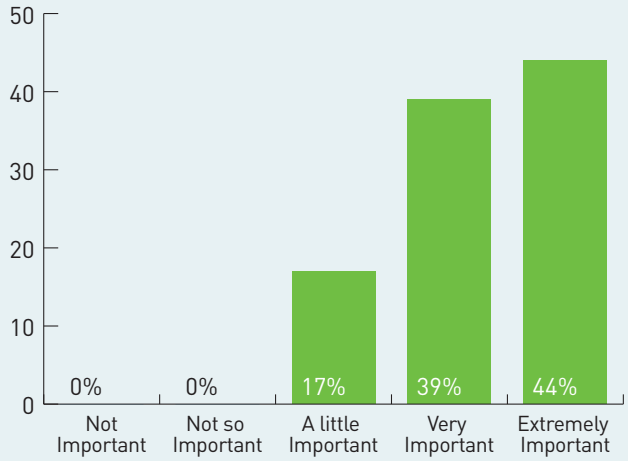
(i) Design Verification.
(ii) IC Design (various topics).
(iii) Software (various topics).
(iv) Data Analytics / Artificial Intelligence / Machine Learning.
(v) Business / Entrepreneurship.

The CPD Module strategy will be discussed in more detail later in this report.

One of the aims of this project was to explore if a third training strand focussing on soft skills should be put in place. The MIDAS Electronics Systems Skillnet does offer a small number of soft skills training courses. The survey sought to discover if training in this area should be expanded.

To Question 10 of the survey *(How would you rate the need to improve Soft Skills in future?)*, more than 80% of respondents rated this to be either very important or extremely important.

FIGURE 16 ▸ SOFT SKILLS

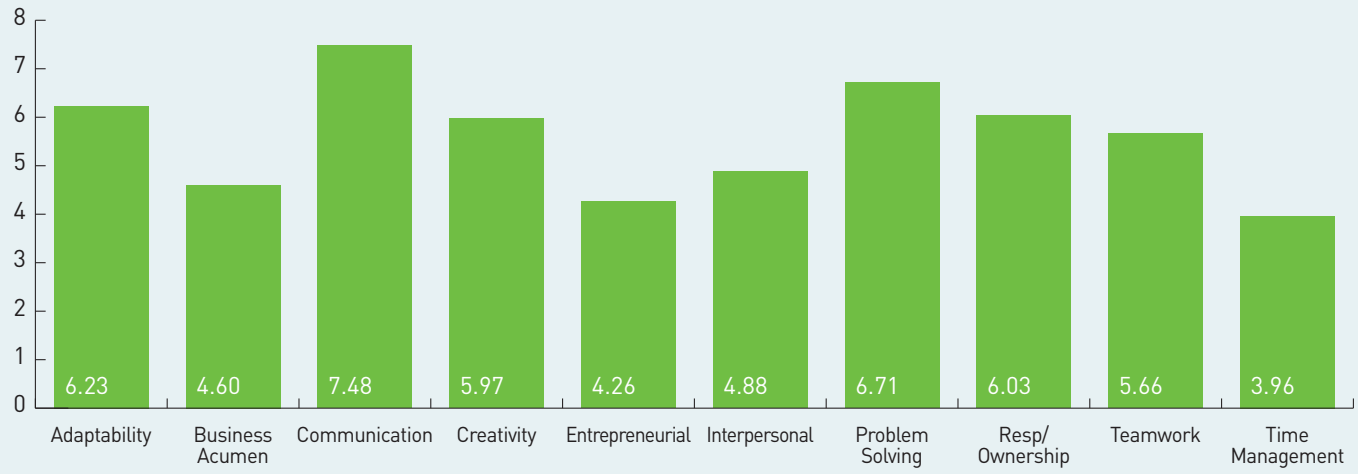


From the leader interviews, it was found that some companies were very interested in having a broad range of soft skills training made available to the sector while other companies have internal soft skills training programs that they say satisfy their needs.

In analysing the responses to Question 11 of the survey *(Rank the following list of Soft Skills in order of future importance)*, communication, problem solving and adaptability ranked highest, but there was not a clear overall answer on where to focus a soft skills training programme.

Further discussion did take place with the companies on how to structure a soft skills training programme which will be discussed in more detail later in this report.

FIGURE 17 ▸ SOFT SKILLS

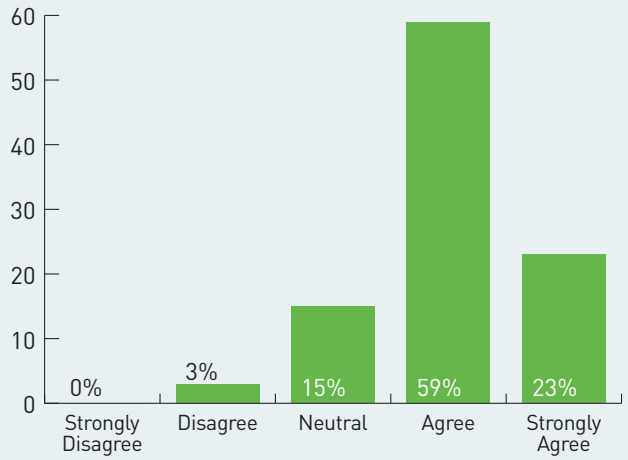


Findings 4:
Graduate Education

Several questions in the survey related to graduate education, which is very important to the sector as about one third of the hiring is of college graduates.

To Question 15 of the survey *(A future graduate's capability will need to be improved when compared to today?)*, more than 80% of respondents either agreed or strongly agreed.

FIGURE 18 ▸ GRADUATE CAPABILITY



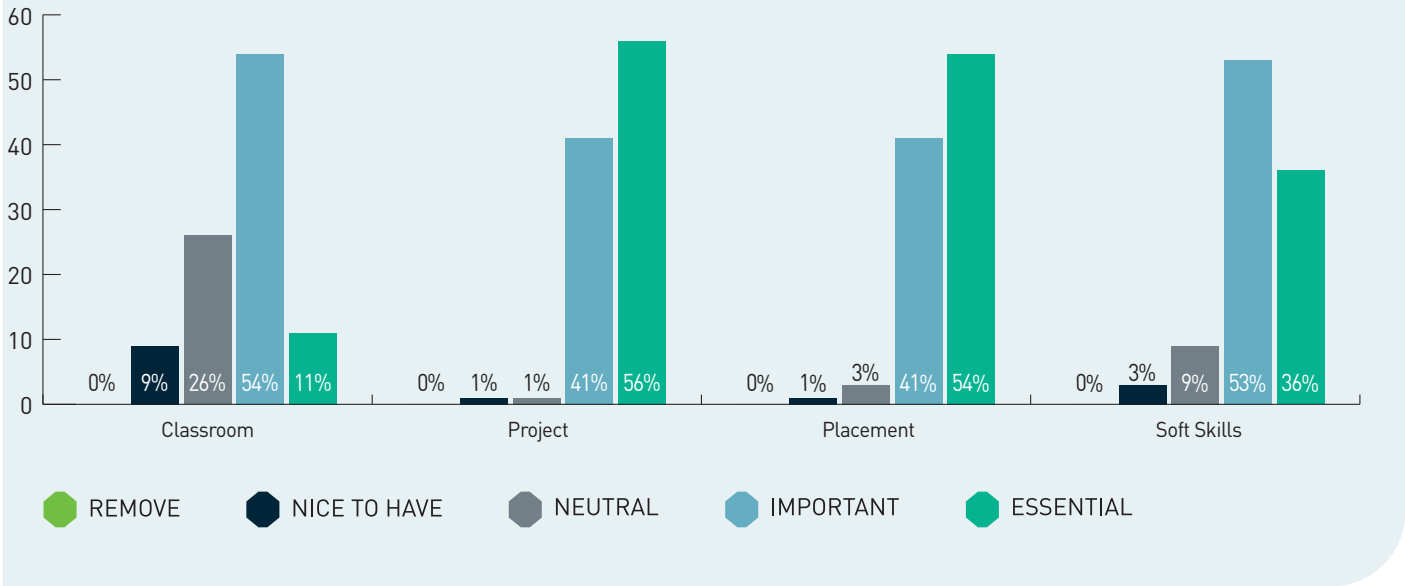
To Question 16 *(What new or broader / deeper subject knowledge would you like to see in a future graduate?)* of the survey, respondents provided their suggestions. The following is a high level summary of the suggestions.

(i) IC Design (various topics)
(ii) Software (Coding, Firmware, Python, etc)
(iii) Soft Skills.
(iv) Systems (Various Topics).
(v) Data Analytics / Artificial Intelligence / Machine Learning / Mathematics.

This was discussed in the leader interviews and there was general agreement that having a forum for the electronics sector to discuss course content with the third level colleges is desirable.

To Question 17 *(Could you give your view on the value of each of the following learning styles as part of a graduate's preparation for joining the workforce?)* of the survey, respondents scored work placements and projects relatively higher than classroom work. Soft skills also scored highly.

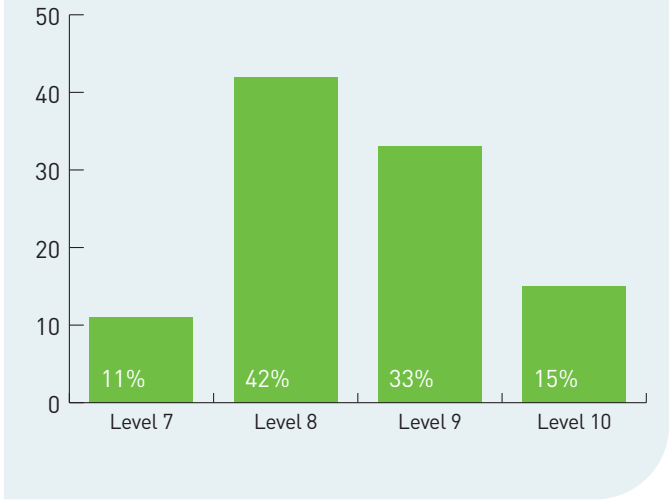
FIGURE 19 ▸ GRADUATE LEARNING STYLES



How to interpret this response was discussed during the leader interviews. The consensus was that the theory learned in the classroom should be viewed as the foundation. Then the practical application of that theory, through work placements / internships and industry relevant project work, needs to be built on top of that foundation to provide a student with the skills needed to work in industry.

For Question 18 *(In terms of future graduate hiring what should be the % split across the various educational levels?)* of the survey, the combined response provided the following profile.

FIGURE 20 ▸ GRADUATE HIRING



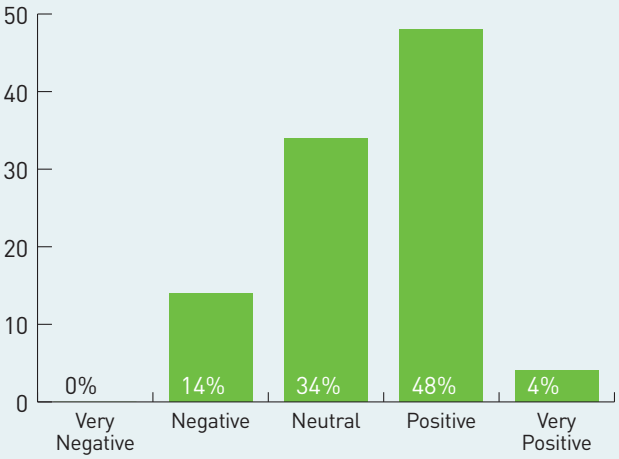
There are two conclusions that can be drawn from this response.

Survey respondents said that future graduate hiring will demand an increased percentage of graduates educated to Level 9 and Level 10 standard than is the case today.

There is a significant demand for more suitably qualified Level 7 (Technician) graduates than are working in the electronics sector today, which is at only about 2%. This was explored in more detail during some of the leader interviews. A number of leaders said that they would like to be able to hire more technicians for roles that their skillset is suited to, but find difficulty in finding enough suitable candidates. In many cases, more highly qualified Levels 8's are asked to perform functions that they are not ideally suited to. Conversely, there are some other companies that have a policy of only hiring Level 8's or above into R&D roles.

To Question 19 *(How do you believe a recent Electronic Engineering Graduate perceives the electronics sector as a career option?)* of the survey, respondents gave a slightly better than neutral response.

FIGURE 21 ▸ GRADUATE PERCEPTION

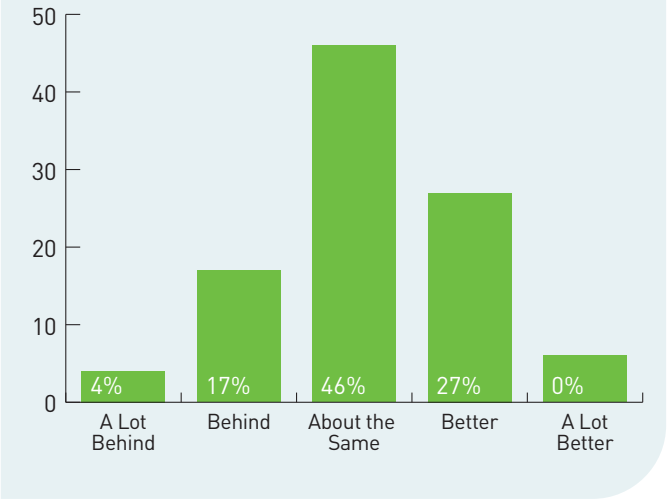


Note that the respondents to this question were mostly the senior leaders and engineering leaders, and not the graduates themselves. In discussions, most leaders felt that this was not a very positive result, and maybe there would have been an even less positive answer if the graduates themselves were asked, or if graduates who don't work in electronics were asked, it might be even more negative. The consensus was that it points to a need for the sector to step up its outreach activities to students and improve the sector image as a good place for graduates to choose for their careers.

Findings 5: International

To Question 20 *(How would you rate the skillset and skill level of the typical engineer working in the Irish Electronics sector, when compared to what you see in other countries?)* of the survey, respondents said they believe the skillsets of engineers in Ireland is similar, or maybe even slightly ahead, to what they have seen in other countries.

FIGURE 22 ▸ INTERNATIONAL COMP



This is a reasonably positive result. However, it's good to be constantly looking for opportunities to improve.

To Question 21 *(What best practices have you seen in other countries in terms of developing a highly skilled workforce?)* of the survey, respondents provided their suggestions. The following is a high level summary of what they have seen that seems to be working well.

(i) Graduate internship and apprenticeships are commonly used.

(ii) There is significant ongoing CPD within companies along with extensive use of industry training courses.

(iii) Graduate educational content is often broader and deeper.

(iv) A longer college education to five years / Level 9 standard is common, and engineering as a profession has a higher status.

(v) Academia / industry collaboration on research and work assignments.

To Question 22 (*During recent years, has your company needed to hire and locate R&D teams outside Ireland, due to resource and skill shortages in Ireland?)* of the survey, about 50% of the companies that responded to the survey answered 'yes' to this question.

Both MNCs and SMEs are locating R&D teams outside Ireland to support their Irish operations.

This is a very concerning response, and during the leader interviews, when this was discussed, the majority of people confirmed that decisions to open R&D centres outside Ireland were made primarily due to not being able to hire sufficient people locally. Leaders also confirmed that they did not make these decisions for cost reasons or because particular skills were not available in Ireland, and that they would have preferred to have located these teams in Ireland. That said, most people said that the remote teams are working out well.

In the survey, respondents quantified how many R&D jobs have been lost to Ireland for this reason. The total came to at least 1,000, with about 15% to 20% of these for the SME sector.

This points to a conclusion that the overall talent pool in Ireland for electronics is too small.

Findings 6:
New Skills for the Electronics Sector

As seen in the earlier findings on future trends, there are several factors requiring new and broader skillsets across the electronics sector. Engineers will need to understand different aspects of electronic systems spanning both hardware and software, as well as end applications. Data analytics, artificial intelligence and machine learning areas are also growing in importance. These are mostly relatively new skills for the sector.

Questions 23 *(People with skills that could move to the electronics sector without significant re-training)* and 24 *(People with skills that could move to the electronics sector but would need some re-training)* were aimed at soliciting respondents views on attracting people with desired new skills into the electronic sector.

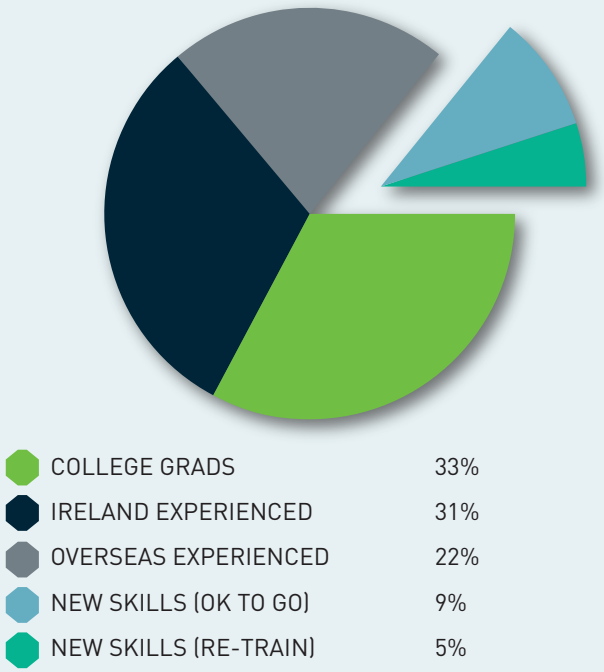
The following is a high-level summary of the responses.

(i) Skills that can be used immediately with minimal re-training.
  (a) Software.
  (b) Data Analytics / Artificial Intelligence / Machine Learning.

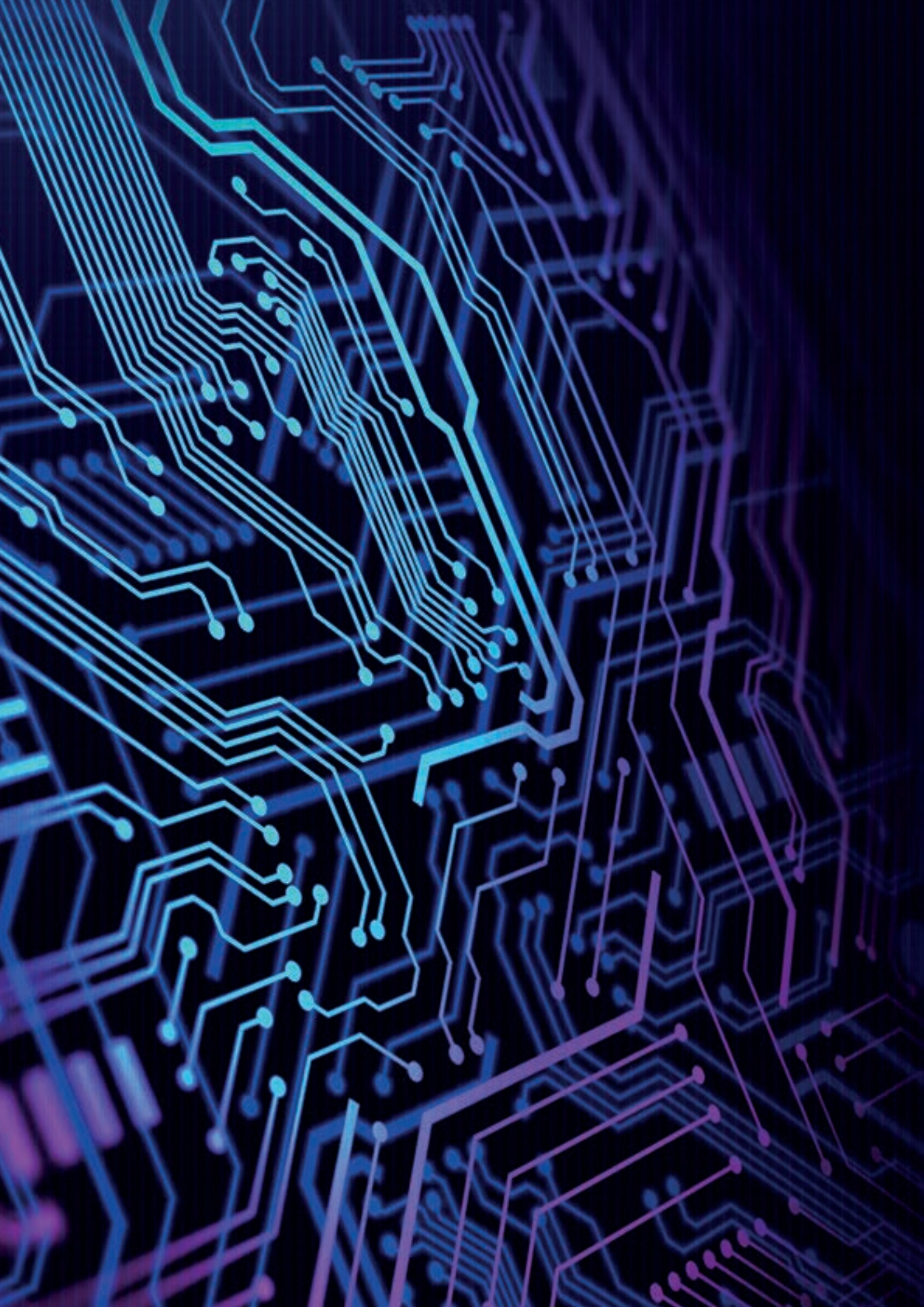
(ii) Skills that can be used with some re-training.
  (a) Mathematics.
  (b) Physics.
  (c) Software.
  (d) Data Analytics / Artificial Intelligence / Machine Learning.

For Question 25 *(In terms of an overall balanced future hiring strategy, what should be the % split across various sources of talent?)* of the survey, the combined response says that the sector would like to allocate about 15% of its future hiring to people with new skills that the sector needs.

FIGURE 23 ▸ SOURCES OF HIRING



This is an interesting result as feedback from the leader interviews suggests there is much less of this hiring currently taking place. These discussions also confirmed that the result from this question is correct and the leaders believe that 15% is a good number for the electronics sector to target.



chapter **FOUR**

Recommendations

Recommendations

Once the survey was completed the results were analysed and some possible actions were noted arising from the responses to each question. The actions arising from all the survey questions were then put together and grouped. Similar actions were combined, some others fine-tuned, a small number put aside, etc, to produce an initial draft of 19 recommendations.

This initial draft set of recommendations were used for the leader interviews. Discussions took place with more than 20 leaders, from across 17 companies with a good mixture of MNCs and SMEs. The draft recommendations were also used in discussions with various stakeholders.

From these discussions some further combining and fine-tuning of the recommendations took place with a final set of recommendations produced. The recommendations are across four categories and aligned with the overall goals of the project. Category 1 aligns with the skills needs, categories 2 and 3 align with the resource needs, and category 4 is on the sector image which is deemed critically important and needed to support the other categories.

The following chart shows the final set of recommendations.

Skills / Training	Resources - Graduates	Resources - Increase Talent Pool	Sector Image
1a. Continue to offer Short Training Courses in support of the needs of the Companies.	2a. Put in place a process with the Irish Colleges to discuss course content and optimum learning styles to support the Electronics Sector's future needs. Investigate if an apprenticeship programme can be put in place to help increase the supply of Level 7's (Technicians). The ultimate goal is to increase the pool of graduates available to the sector for hiring at the various educational levels.	3a. Develop a plan on how to attract engineers with New Skills to work in the Electronics Sector. These engineers may already have the necessary skills (e.g. software engineers, data analytics) or need some re-training (e.g. physics, mathematics). Put the required CPD and re-training initiatives in place to support this process.	4. Promote the Electronics Sector as a great place for people to build their career. This includes promoting Engineering as a Profession, Electronics' positive contribution to society's needs, as well as highlighting the financial attractiveness of the sector.
1b. Develop new CPD Modules in support of the needs of the Companies. Explore how a path to a formal Educational Qualification (e.g. Masters) can be put in place.	2b. Companies to engage with colleges and improve support for Work Placements and Industry Relevant Project Work aligned with future skill needs and with optimum Graduate Learning Styles.	3b. Increase hiring into Ireland from abroad (currently at ~35%) to increase the available talent pool and minimize loss of R&D positions to other countries. Put support in place to assist people with the logistical challenges of moving, and for companies to make the process easier.	
1c. Develop a plan for and put in place Soft Skills Training for the Electronics Sector Employees.	2c Step up Student Outreach and Engagement to build the brand of the Irish Electronics Sector with students as an attractive sector in which to build their career.		

The next chapter of this report discusses each of these recommendations in more detail, and proposes an action plan for each.

chapter **FIVE**

Action Plan to Support Recommendations

Action Plan to Support Recommendations

Category 1: Skills / Training

Action 1a
Continue to offer Short Training Courses in support of the needs of the Companies.

General Comments:

For Question 3 *(What future trends do you expect to have an influence on the electronics industry?)* of the survey, a majority of the responses could be grouped into the following general categories, and the associated comments suggested what this would mean for future sector skills.

Future Trends in Electronics	What the Trends mean for Sector Skills?
Environment / Energy Conservation	*Low Power Design Techniques*
Data Analytics / AI / ML	*Data Analysis -- New Skills for the Sector*
Automotive - EV / Autonomous Driving	*More Robust Design, Verification*
Future Healthcare	*Systems (Silicon to Software)*
How we Live & Work in Future	*Soft Skills Increasingly Important*

The following is a short summary of the future improved skills and training needs as articulated by responses to Question 6 *(What new skills or skill improvements do you see that will be required by the engineer of the future?)* and Question 7 *(What new training initiatives would you like to see to upskill the engineering workforce in the electronics sector?)* in the survey.

Area	Proposed Short Training Courses	#	#-Number of Interested Companies	#		#
IC Design	Analog / Low Power	4	Higher Level Design / Synthesis	7	Power Electronics / Digital Control	4
	Mixed Signal	5	DSP	5		
	Digital / RTL	8	Advanced Tools / Simulation / Modelling	5	Wide Bandgap Semiconductors / New Materials	1
			Design at Advanced Nodes	7	RF Design	3
High Frequency / Hardware	Millimeter Wave Design Techniques	4	FPGA Programming / Realtime Prototyping	4	RF Antenna Design	2
	EMI / EMC Design Techniques & Best Practice	6	Advanced Packaging	3		
Verification	General UVM Verification Methodologies	8	Advanced Verification Techniques	9	Mixed Mode Verification / Modelling	6
Software / Firmware	Programming / Coding	4	Firmware / Embedded Systems	6	Virtual Reality / AR / Neural Networks	1
	Python	7	C/C++/SystemC - higher abstraction	4	Abstract programming for higher efficiency	2
	Secure Coding	2	Scripting	3		
Systems Design	Systems Knowledge / Architecture	6	Algorithmic Knowledge	5	Application Knowledge / Specs	2
	Software Programming Tools	4	Modelling at System Level	7	Wireless Applications	1
Cross Discipline HW / SW Mix	Mixed Hardware & Software Design Skills	4	Flexibility to operate on multiple work flows	2	Broad skillset - Physical/ Thermal/ System level	1
	Vertical Integraton of Enginering skills	2	Integration with scientific disciplines	1	Cross discipline (mech with elec etc)	0
	Co-definition of HW and SW working together	3			Prototyping - HW and virtual	2
Data Analytics	Data Analytics	5	Quantum computation	2	Domain & system expertise in ML & comp vision	1
	Artificial Intelligence	4	Big data processing and analysis	2		
	Machine Learning	5	Data storage and management	2	AI implementation/ application in IOT networks	2
					Power BI (Microsoft Big Data Application)	2
Business	Commercial understanding	5	Understanding Customers	3	Finance for Engineers	4
	Entrepreneurship	2	International Markets	3	Account Management - App / Comp Needs	2
Other	Functional Safety / ASIL-D ISO26262	5	Increasing Productivity / Process Automation	3	Mentoring	3
					IP / Patents, Understanding Design	2
			IT Skills	1	Novelty	

This list, which came directly from the survey responses, spreads the net broadly in terms of the areas that training might need to address and also picked up as many individual topics as possible as all survey respondents' inputs were taken into account.

It is likely that much of the above list of suggested training topics can be addressed through short training courses, similar to what the MIDAS Electronics Systems Skillnet organizes on an annual basis.

However, a few of the topics may be best addressed through deeper CPD Modules which typically extend over a 12-week semester. These will be discussed under Action 1b.

As a follow-on to the leader interviews, more detailed discussions on training needs took place with representatives of the ten largest companies, as it was expected that their needs would be generally representative of the whole sector, and these companies would have the numbers to justify putting on a particular short training course. These companies have a combined total of about 2,000 R&D positions, so represent about two thirds of the overall R&D population. It is hoped that the smaller companies' needs would be generally aligned and that they could take advantage of any course that is offered that they are interested in.

There are a total of 60 training topics listed in the chart above, and the numbers listed beside each topic represent the number of the larger companies who expressed an interest in having some of their engineers attend a training course on that topic. Typically, they each suggested two to five engineers attending a particular training course, so from this it was assumed that if there were at least four companies interested, then there are likely sufficient numbers for a course to be viable, when attendees from the other companies in the sector are also considered. 29 of the topics meet this >=4 criterion so it is recommended that the MIDAS Electronics Systems Skillnet consider further investigation of these topics, and maybe a few of the others also.

During the various interviews and discussions it was suggested by a cohort of respondents that having a mechanism, to acquire credits from attendance at and completion of multiple short training courses, that could lead to a higher qualification like a Diploma or Certificate would be desirable. It is not clear what process needs to be put in place. One challenge would be around the certification of the courses and the associated extra work and whether the return is there for the extra layer of complexity / administration.

Suggested Action Plan:

The MIDAS Electronics Systems Skillnet, through its Skillnet Steering Group, needs to engage with its member companies to plan an expanded and broader offering of short training courses which is aligned with the needs expressed during the company survey, leader interviews and follow-on training needs discussions.

This process needs to be repeated on an annual basis going forward, while ensuring that the training courses stay aligned with evolving training needs.

The MIDAS Electronics Systems Skillnet should investigate if it is possible to put in place a mechanism to acquire credits from attendance at and completion of the short training courses that could lead to a higher qualification like a Diploma or Certificate.

Action 1b
Develop new CPD Modules in support of the needs of the Companies.

Explore how a path to a formal Educational Qualification (e.g. Level 9 / Masters) can be put in place.

General Comments:

The CPD Modules were originally conceived to address a gap whereby newly graduated engineers have a hill to climb to be competent as independent engineers after they start in industry. It was observed that this gap was sometimes filled in other countries though focussed Masters programs. A similar approach was proposed in Ireland and there were discussions with a number of electronics companies from about 2015 which suggested significant interest.

In 2019, the current CPD Module approach was initiated, with the first CPD Module developed in Analog IC Design. This was developed with funding from the MIDAS Electronics Systems Skillnet and ran for the first time during the Autumn of 2019, and is being run for the second time during the Autumn of 2020. The teaching approach is primarily on-line with labs and examinations included.

A second CPD Module in Digital IC Design was then developed. This follows a similar approach and is being run for the first time during the Autumn of 2020.

A third CPD Module in IC Design Verification is currently being proposed under the guidance of a CPD Module Steering Group representing the interested companies, with a view to developing and offering it for the first time during 2021.

The development and accreditation of these modules involves significant effort and they are being funded by Skillnet Ireland and the member companies via the MIDAS Electronic Systems Skillnet.

Some of the key criteria for these CPD Modules are that the course content is defined by the interested companies and that the practical skills that an engineer needs to work in industry are taught, preferably by an academic staff member who has had significant industrial experience during their career.

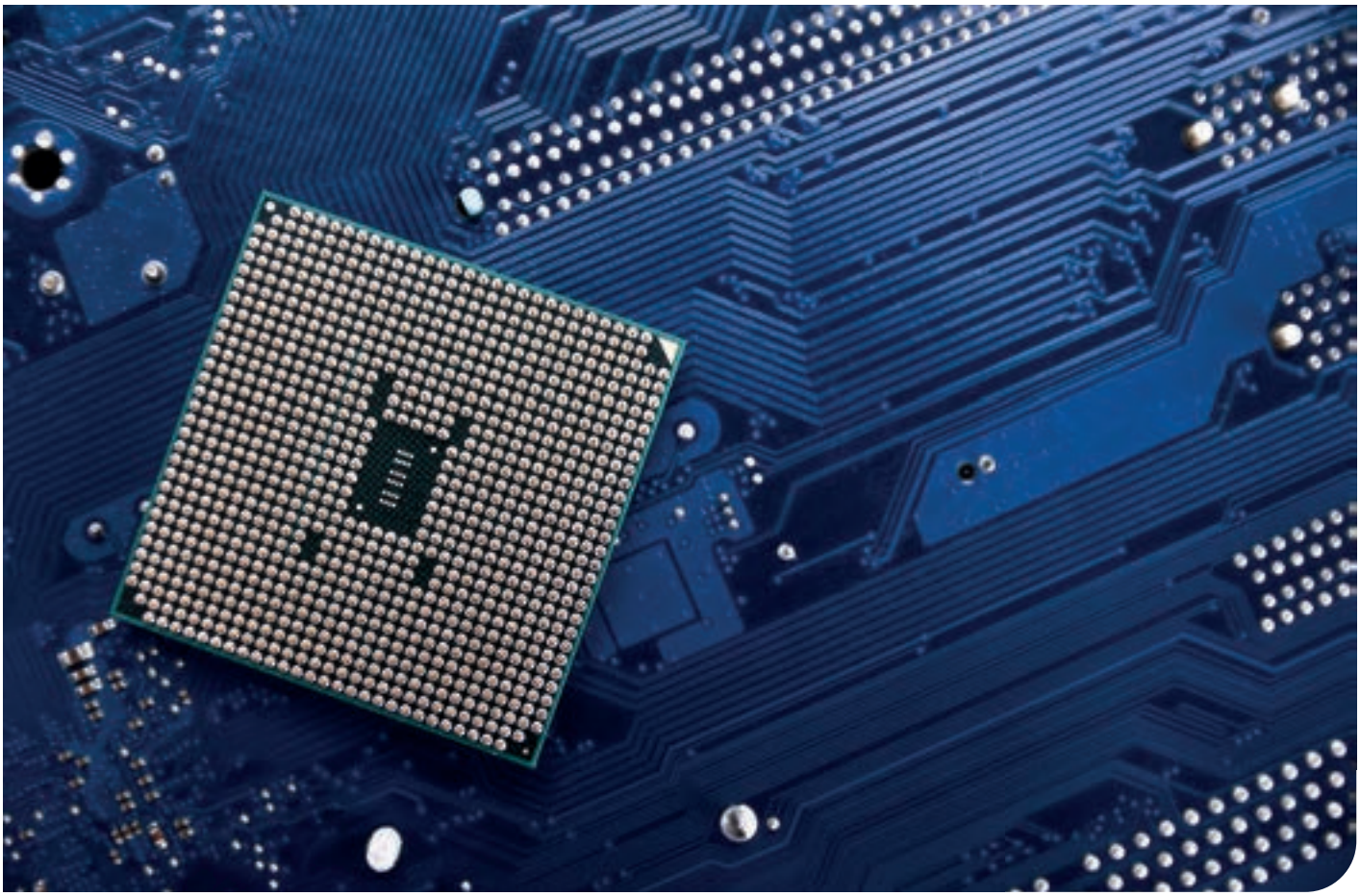
As such, the approach differs from what is normally available from a typical Masters programme available today from the Irish third level colleges. It is not necessarily meant to replace or be in competition with these other Masters programmes, but offered as an industry lead alternative to provide the specific training which member companies have requested for engineers who want to improve their capability to work in industry.

One of the primary aims of this research project is to determine the level of support from industry for CPD Modules since evidence of industry support is a fundamental prerequisite for any future CPD Module development.

The general feedback from the companies during the leader interviews was very positive as regards what they have seen so far from the CPD Modules, and this is evident from the numbers that are signing up for and attending the training. They see a lot of value in the practical / hands-on approach to teaching and learning, as the focus is on practical examples, realistic projects and the latest industry trends. This works well for people who already have sufficient background and do not need to focus so much on learning theory. A CPD Module can be targeted at a specific need and is seen as good value for money. The training can be targeted at junior engineers or more experienced engineers who might be moving into a new role and allows them work on something new pretty much immediately. See more detail on some of the related comments from industry at the end of this section.

The following is a short summary of the responses to Question 12 *(What Level 9 CPD Modules do you see a future need for?)* in the survey.

Area	Proposed New CPD Modules # - Number of Annual Attendees	#
Verification	1. Design Verification (Maybe the proposed CPD Module) 2. Design Verification - Advanced	20 25
Analog Design	1. Basic analog design techniques (Maybe the existing CPD Module) 2. Design on advanced process nodes (e.g. using FinFETs) 3. Digitally Assisted Analog Design	3 18 11
Digital Design	1. Advanced Logic (synth/ verif) 2. SoC system - how it works, CPU flow etc 3. Processor and Platform Architecture	21 17 22
RF / EMI	1. RF Design Techniques 2. EMI / EMC Design Techniques & Best Practice 3. Antenna Theory	9 9 4
Power Electronics	1. Power electronics and motor control, higher voltages and powers 2. Highly efficient power system design based on SiC and GaN technology	1 1
Systems Design	1. Systems Design - looking beyond Si to a full solution. S/W for H/W Engineers	23
Software	1. Secure coding, Ethernet & Packet Processing 2. FPGA programming for beginners through to advanced	5 3
Data Analytics	1. Data Analytics 2. Artificial Intelligence 3. Machine Learning	12 10 12
Business	1. Business Skills for Engineering Leaders 2. Entrepreneurship	7 0



As a follow-on to the leader interviews, more detailed discussions on proposed new CPD Modules took place with representatives of the ten largest companies, as it was expected that their needs would be generally representative of the whole sector, and these companies would have the numbers to justify the investment to develop any new CPD Modules. These companies have a combined total of about 2,000 R&D positions, so represent about two thirds of the overall R&D population. It is hoped that the smaller companies' needs would be generally aligned and that they could take advantage of any CPD Module that is offered that they are interested in.

There are a total of 21 proposed CPD Modules listed in the chart above, and the numbers listed beside each topic represent the estimated combined number of annual attendees from the larger companies. It is understood that a class size of 15 to 20 makes a CPD Module viable. Seven of the topics meet this >=15 criterion so it is recommended that the MIDAS Electronics Systems Skillnet consider further investigation of these topics for CPD Module development. There are also a few other topics that likely also merit consideration, as some of these topics, for example those in the RF/EMI or Data Analytics areas that might be combined or broadened in some way to make them viable. Of course, there may be additional interest from the other companies across the sector which would add to these numbers.

As more CPD Modules are developed, it has been suggested that having a path to formal Level 9 qualification for engineers from industry that complete a number of CPD Modules is desirable and likely a motivator for them to actively pursue CPD throughout their careers.

The general feedback from the leader interviews was that a path to a Level 9 qualification should be actively investigated.

The already developed CPD Modules each qualify for 5 to 10 ECTS credits at Level 9. For a Level 9 Degree, 90 ECTS credits are needed, so it may be that as few as 4 to 5 CPD Modules, along with a few 'standard' College Modules and a Project / Thesis (30 ECTS credits), would be needed to accumulate sufficient ECTS credits for a Level 9 Masters accreditation.

The challenge in putting the required path to a Level 9 qualification in place is that the ECTS credits would likely be coming from a number of third level institutions. Likely one college would need to take the lead and

award a Degree based on at least some of the ECTS credits coming from other colleges. The framework for education awards is outlined in the National Framework of Qualifications which is managed by Quality and Qualifications Ireland – (www.qqi.ie).

If such a path to a Masters can be put in place, and the CPD Modules exist to support it, then in addition to this programme being available to engineers from industry, it may be that the programme could also be made available to college graduates directly after they finish their Level 8 (or maybe Level 9) degree programmes, before they take up a place in industry. It is possible that some companies might want to offer support or encouragement to graduates / potential new hires to pursue this alternate path.

It might also be desirable to have an option to award a Level 9 Post Graduate Diploma to any students on the basis that they just complete the CPD Module part of the programme (60 ECTS credits), and who choose not to pursue the project / thesis.

With two CPD Modules developed, three or four more are needed to support the Level 9 qualification requirements (Masters or Post Graduate Diploma) and there may be a base level of CPD Modules, e.g. Analog IC Design, Digital IC Design, IC Design Verification, SoC Design, that are attractive to give a young IC designer the necessary base skillset, so putting this in place for the sector is something that should be achievable in the short term, maybe within two to three years.

Further down the line, as more CPD Modules are developed and available, specialisation in the programme offerings could be part of a future roadmap, in for example Analog Design, Converter Design, Digital Design, RF Design, Power Electronics, etc.

A major challenge that exists is finding an academic staff member with sufficient industrial experience to teach a particular CPD Module that is selected for development. A proposal that could be considered to address such a gap is to pair an academic with an experienced industry person or a private sector trainer to develop and teach the CPD Module. The experienced industry person might be recently retired or a company may consider a part-time secondment of an experienced engineer.

In summary, putting this in place for the sector is something that would require significant collaboration initiatives to address two major hurdles:

1. Industry and third level colleges to collaborate closely to solve training expertise gaps within third level colleges to enable delivery of more advanced CPD modules e.g. Design Verification CPD
2. Third level colleges to collaborate with each other to facilitate awarding of Level 9 qualifications based on recognising and combining of Level 9 ECTS credits from multiple third level colleges.

Suggested Action Plan:

The MIDAS Electronics Systems Skillnet will need to carry out a more specific data gathering exercise to define the course content for each of the proposed new CPD Modules, and confirm the level of interest. From this, a proposal needs to be put together on a future CPD Module development plan which likely spans a number of years, and which is contingent on the necessary funding support.

The MIDAS Electronics Systems Skillnet needs to work with the various third level institutions to put in place the path to a formal educational qualification (e.g. Masters or Post Graduate Diploma) for any engineers who accumulate a sufficient number of Level 9 ECTS credits through completing multiple CPD Modules.

Comments from Industry:

The following comments are from industry leaders in response to the following question. The comments have been edited slightly, so they read correctly in the context of this report, but without changing what they mean in a material manner, and also to protect the identity of any individuals.

"How do the CPD Modules provide an engineer with the necessary skills to do a job in industry versus a regular taught Masters such as those offered by an Irish University or Institute of Technology?"

> *"We find if an engineer is working already, or implements the learning from the course directly or shortly after the course then we get better quality engineer. The experience of working on a tool on real work with tight schedules is something that cannot be produced in colleges"*

"Just one person so far has attended the Digital CPD Module, so it is too early to provide an opinion."

"It is difficult for me to comment on the differences between Masters programs in Ireland and CPD modules for engineers. Based on my previous experience, the value of external trainings is that it normally goes into practical examples, realistic projects, and the latest industry trends. This works well for people who already have sufficient background and do not need to re-hash textbooks. Masters programs normally focus on fundamentals and often taught by faculty with academic rather than industrial experience."

"CPD is better than Masters in colleges in my opinion. A taught Masters is just more of the same by the same people who did/did not train them in the first instance, key for CPD is to have good trainers with industry experience. Some of the course notes I observed being taught in college are simply wrong, completely out of date with modern synchronous digital design – fundamentals all wrong as well, course notes given by people who never worked in the space and never specialized in the area."

"Some advantages that we see with the CPD Modules:

- *Overhead to do a CPD module is relatively light compared to a 1-2 years taught Masters*
- *Can continue in full-time employment during a CPD module*
- *CPD module can target a specific area of interest / relevance rather than the wider set of topics covered in a Masters*
- *Lower cost than a 1 year Masters*

Big challenge with the CPD Modules is deciding on the topics that will attract enough interest and continuing to see sufficient demand over subsequent years."

"Re the CPD vs taught Masters – the CPD Modules are shorter courses, less commitment, and can be targeted at a more specific need. A Masters will be more broad. Typically targeted at a junior hire who right now wants a refresher course without a longer commitment or at more experienced engineers who are pivoting into a new role, so again a full Masters is not what they are looking for.

I've not had exposure to the CPD teaching methods, but for our needs the hands on practical approach is a better match because the guys we're sending on it are doing so to allow them jump in to do something new pretty much immediately. I do recall there being practical and homework type sessions that were done in groups, so that seemed to work."

"The CPD Modules are much more industry based. The work, tools used and approach is more relevant to tasks the engineers need to do on a daily basis. A Masters course could use similar techniques but typically don't and are more academic based and broader. The CPD Module approach also allows people to pick topics that are relevant to their requirements. e.g. You have an experienced analogue designer who is moving into a chip lead role. They want to understand a bit more about RTL to help them manage the overall project. The digital CPD Module hits that spot, a Masters is too much investment of their time. The same is true of a new graduate starting their career as a digital designer. From a company perspective, a CPD Module aligns well with an annual individual development process. A goal can be identified and a CPD Module can be part of the development plan to address skills gap. A Masters is typically seen as a longer term investment in an employee."

"I see the CPD Modules fitting in for those who don't want to spend more time in college but actually want to get out and start working – the CPD Module approach allows for those that want to work to still continue some level of formal training."

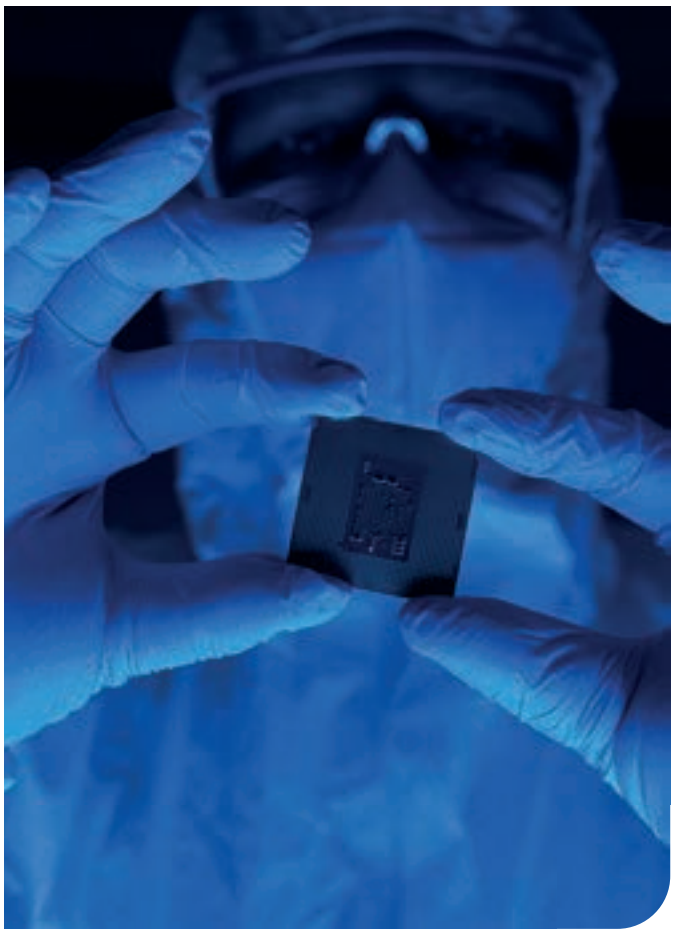
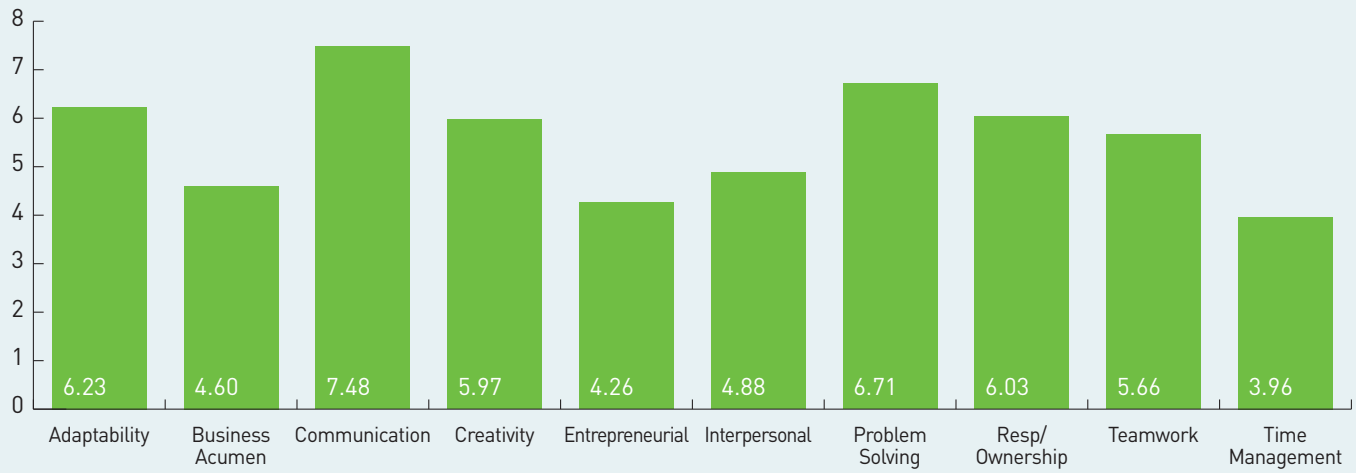


FIGURE 17 ▸ SOFT SKILLS



Action 1c
Develop a plan for and put in place Soft Skills Training for the Electronics Sector Employees.

General Comments:

Over 80% of respondents to Question 10 of the survey said that soft skills are either very important or extremely important.

The various soft skills listed in Question 11 (*Rank the following list of Soft Skills in order of future importance)* of the survey were ranked as in Figure 17 above.

In analysing the responses to Question 11 of the survey, communication, problem solving and adaptability ranked highest, but there wasn't a clear overall answer on where to focus a soft skills training programme.

The MIDAS Electronics Systems Skillnet currently provides some training on soft skills. There is also a plentiful supply of soft skills and professional skills courses available from the various third level colleges, and independent training providers.

One of the aims of this project is to determine the level of support from industry for the MIDAS Electronics Systems Skillnet providing a more comprehensive offering of soft skills training, and if so what would the structure and focus of a soft skills training programme for the electronics sector look like. Should the Skillnet simply provide a gateway to provide access to the existing course offerings or is there a need for something more structured or specific for the sector?

Some research was carried on what a possible soft skills training structure might look like and a proposal focussed around leadership was put together.

Leadership development can be divided up into three categories as follows:

- **Leading Self**
  - This area would be on the soft skills that an individual contributor would need
  - Examples might be active listening or how to challenge their manager in a respectful manner
- **Leading Others**
  - In this case the person might be leading a team or managing a group
  - Managing performance is a key soft skill
- **Leading the Business**
  - Strategic Thinking is a Key Skill

There are also some basic professional skills, like time management, presentation skills, project management, etc, that could be part of any programme.

The following is a framework that was used in discussions on this topic with the leading companies.

Module	Leading Seaf	Leading Others	Leading Business	Duration
Effective Communications for Professionals ▸ Respectful Challenge ▸ The Power of Active Listening	x	x	x	1 Day
Coaching for Effective Delegation & Empowerment ▸ Coaching vs Mentoring ▸ The Coaching Skills of Asking Forward Moving Questions & Active Listening		x		1 Day
The Importance of Self Awareness & Managing Personal Triggers	x	x		1 Day
Performance Management & Effective Succession Planning		x		1 Day
Transforming Conflict into High Quality Collaboration through Valuing Difference	x	x	x	1 Day
How to Build A High Performance Team		x		1 Day
Courageous Leadership through Embracing Vulnerability & Holding Challenging Conversations	x	x	x	1 Day
The Business Benefit of Psychological Safety and How to Create it		x		1 Day
Managing Change	x	x	x	Half Day
Managing Time - Covey's Time Matrix	x	x	x	Half Day
Professional Presentation Skills	x			2 x 1/2 Day
Project Management	x			1 Day
Problem Solving Skills - DMAIC, A3 Problem Solving Tools (Lean Thinking)	x			1 Day
Ethics	x	x	x	1 Day
Managing Multicultural and Geographically Diverse Organizations		x		1 Day

A company could either pick and choose which modules to send their people on, or use it as a framework for overall leadership development / soft skills training and take a group of modules that might lead to a higher level qualification, e.g. 'Diploma in Professional Skills'.

From the leader interviews and follow-on discussions with the larger companies, it was found that some companies are interested in having a broad range of soft skills training made available to the sector, while other companies have internal soft skills training programs that they say satisfy their needs.

From assessing all the combined feedback, the conclusion was that there is sufficient interest in the MIDAS Electronics Systems Skillnet offering a comprehensive programme of soft skills training to the companies in the electronics sector. In fact, the enthusiastic support from a few of the larger companies in the sector is probably strong enough in itself to justify it.

Suggested Action Plan:

The MIDAS Electronics Systems Skillnet needs to engage with its member companies to plan an expanded and broader offering of soft skills training courses which is aligned with the needs of its member companies.

Category 2: Resources - Graduates

Action 2a
Put in place a process with the Irish Colleges to discuss course content and optimum learning styles to support the Electronics Sector's future needs.

Investigate if an apprenticeship programme can be put in place to help increase the supply of Level 7's (Technicians).

The ultimate goal is to increase the pool of graduates available to the sector for hiring at the various educational levels.

General Comments:

There was an extensive list of suggestions in the survey in response to Question 16 *(What new or broader / deeper subject knowledge would you like to see in a future graduate?)*.

The following is a high-level summary of the various suggestions:

Area	Proposed Short Training Courses		
IC Design	Analog Design Mixed Signal Design	Digital Design Signal Processing	Design at Advanced Process Nodes Device Physics
High Frequency	RF / Millimeter Wave Design Techniques	EMI / EMC Design & Best Practice	High Frequency Electronics Assembly
Power Electronics	Power Electronics / Motor Control	Wide Bandgap Semiconductors	Power SoC
Verification	General UVM Verification Techniques	Verification Tools & Methodologies	
Software / Firmware	Programming / Coding Python / Scripting	Firmware / Embedded Systems C/C++/SystemC	Object Oriented Programming Software at Systems Level
Systems Design	Systems Knowledge / Architecture	System Thinkers System Design & Debug	Application Knowledge / Specs
Cross Discipline	Embedded Systems Design (HW & SW)	FPGA Programming	Hands-on skills
Data Analytics	Data Analytics Artificial Intelligence	Machine Learning Deep Learning	Mathematical Methods Statistics
Business	Commercial understanding	Finance Skills	Marketing / Customers
Soft Skills	Communication	Time Management	Interpersonal
Other	Problem Solving / Getting a Result	IT Skills	IP / Patents, Understanding Design Novelty

This summary needs to be used in discussions on future course content with third level colleges.

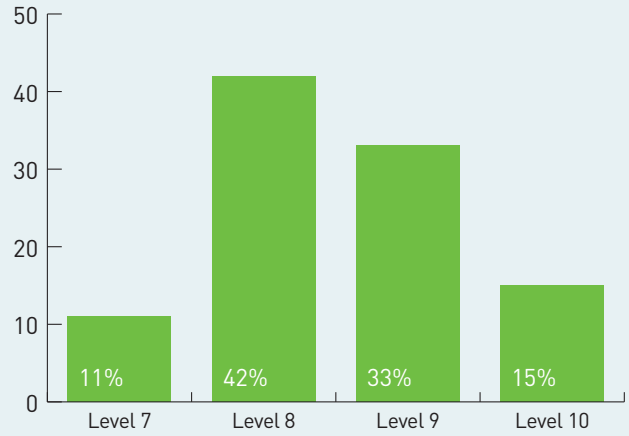
There were also some related comments in the survey responses on international comparisons around broader and deeper learning, and a longer college education.

The recent hiring data from the survey suggests that over a third of the sector hiring is of graduates, at a rate of over 100 graduates per annum during the past three years. This ratio is predicted to be approximately maintained, however the overall numbers to be hired each year are predicted to grow.

Other data from Question 22 *(Has your company needed to hire and locate R&D teams outside Ireland, due to resource and skill shortages in Ireland?)* suggests that significant jobs in the sector are being lost to other countries due to a lack of overall resources available to hire in Ireland. The only way to sustainably address this shortage in the longer term, and increase the available pool of talent to fill positions in Ireland, is to increase the overall pool of graduates available to the sector for hiring. (Hiring from abroad to fill positions in Ireland will continue to be required, but there is only so much of this that can be done and is likely desirable in any case.)

Another aspect to graduate hiring is to align with the evolving nature of future trends and what new skills are needed. The sector should look at what disciplines, beyond the traditional electronic engineering base, that should also be considered in an overall balanced hiring strategy. There needs to be engagement with college courses that produce graduates with software and data analytics skills, and skillsets in the systems and applications areas like biomedical, environmental, automotive, etc.

FIGURE 20 ▸ GRADUATE HIRING



The responses to Question 18 of the survey show an evolution in the desired educational attainment level for future graduate hiring, with an increasing percentage of Level 9 and Level 10 hires.

During the past few years there has been a move from the traditional four year Level 8 college education to 3+2 or 4+1 models whereby a Level 8 is attained after three or four years on the way to a Level 9 after an additional one or two years. This seems to be generally aligned with what industry is asking for. That said, the majority hiring is predicted to remain at Level 8, so it is not a 'one size fits all' situation. A concern has been expressed in some discussions that if a five year degree becomes the norm it might have the unintended consequence of appearing to set the entry bar too high and decrease entry into engineering courses. There has also been a suggestion that this happened at Level 7, with the majority of students aiming for Level 8, and consequently resulting in a shortage at Level 7.

Common engineering entry means disciplines need to compete for the attention of students during the first year. Some colleges are taking innovative approaches to how they are teaching electronics during the first year so they can attract a higher proportion of the students when they decide which discipline to continue with.

There is also an increasing variety of paths through the educational system. Colleges take different approaches, so the industry needs to be able to engage in a flexible manner to attract the increasing diversity in skills that will be needed. An area to increase focus on might be post-graduate degrees for the electronics sector that attract in students from various disciplines like mathematics, physics, science, computing, etc.

Note also that the survey suggests a need for a higher percentage of Level 7's (Technician grades) than are currently employed in the sector. During the leader interviews there were related comments around the challenges to 'hire good technicians' and the desire not to have more highly qualified Level 8 engineers doing work that is more aligned to technicians' skillsets.

Meetings were held with about ten third level colleges, which included about an equal proportion of universities and institutes of technology (IoT). The general feedback is that the various colleges are more than willing to engage with the electronics sector on a process to have the necessary discussions in these areas.

Some discussions took place with the IoTs on what can be done to increase the supply of suitably qualified Level 7's. One very worthwhile suggestion was to put an apprenticeship programme in place to produce a supply of suitably qualified electronics technicians. This approach would also have the effect of making the Level 7 career option more attractive. There were some suggestions in the survey that the apprenticeship education model has been seen to work well in some other countries.

There are more third level colleges and it was just the time available during the project that limited the number of meetings that were possible. As such the feedback is being interpreted as being generally representative of the third level engineering education sector.

Suggested Action Plan:

Initiate discussions with colleges on future course content and optimum learning styles to support the electronic sector's future resource and skill needs.

The companies should form a cross sector team to articulate the sector's needs from graduate education, and who can engage directly with the colleges. A process needs to be out together whereby this team meets with the various colleges on a regular, probably annual, basis. What is generally true is that the electronics sector needs to get better at articulating its needs and its image, and if possible, speak coherently as a sector and engage in constructive discussions with the various colleges.

Industry should align its engagement model with colleges to take account of the broadening skillset and new skills that the electronics sector needs.

In conjunction with the colleges, investigate if an apprenticeship programme can be put in place to help increase the supply of Level 7's (Technicians) to the electronics sector.

Funding for 'extras' on third level courses is often a challenge. An industry support model should be considered and would likely help a lot, whether that be in the form of sponsorship of labs, donating equipment, guest lecturing, student mentorship, etc.

Support from the state agencies, like IDA and Enterprise Ireland, will also be helpful when influence at government, HEA and college leadership levels is required to support the electronic sector's needs in term of graduate skills and numbers available to the sector for hiring.

Action 2b
Companies to engage with colleges and improve support for Work Placements and Industry Relevant Project Work aligned with future skill needs and with optimum Graduate Learning Styles.

General Comments:

In response to Question 17 *(Could you give your view on the value of each of the following learning styles as part of a graduate's preparation for joining the workforce?)* of the survey, work placements and industry relevant project work scored highest, followed by soft skills with classroom work scoring relatively the lowest.

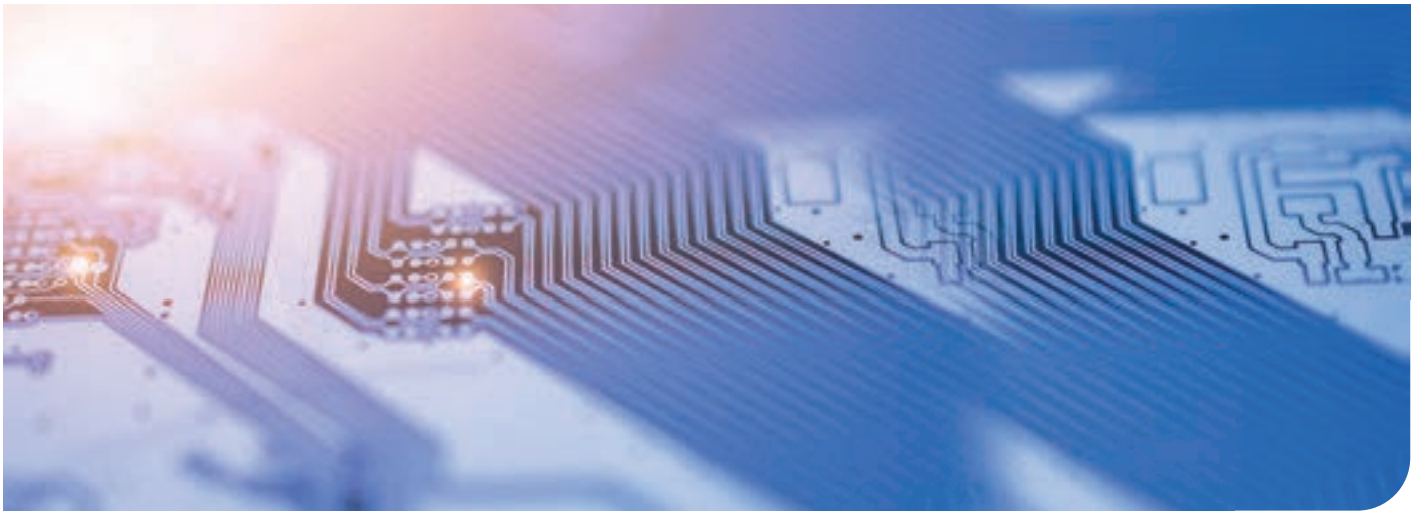
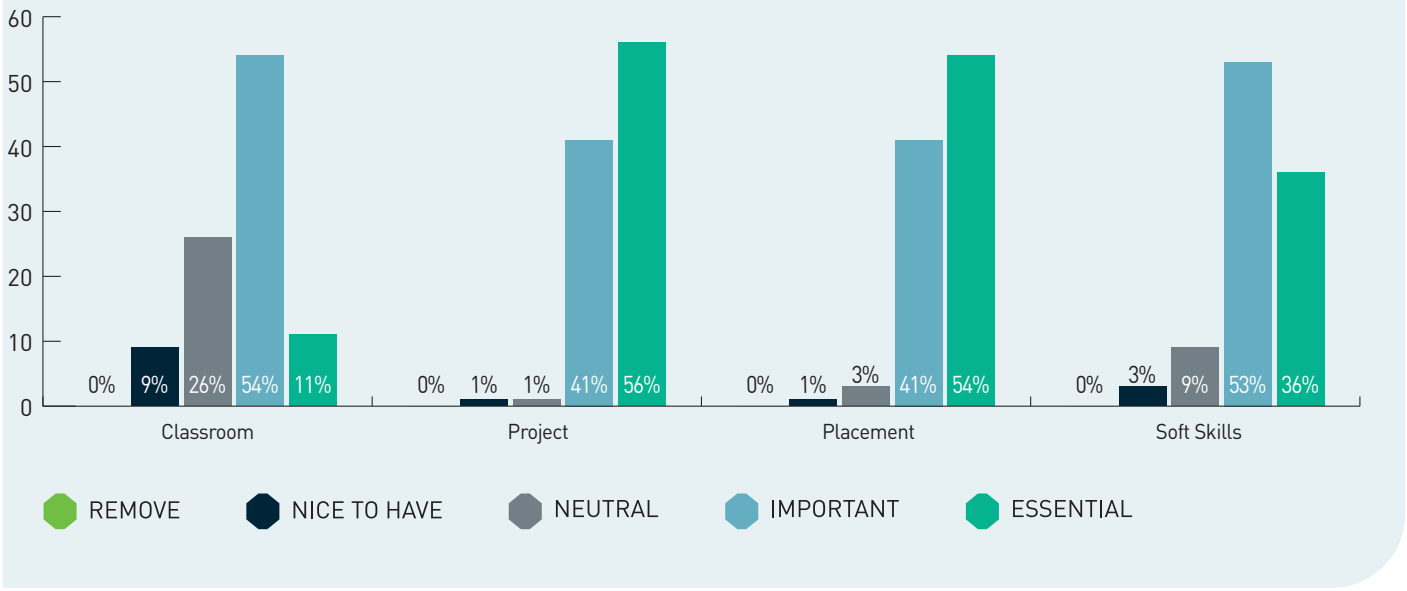


FIGURE 19 ▸ GRADUATE LEARNING STYLES



Classroom work is important as it is the foundation on which on which everything else is built on. However, the practical insights from industry relevant project work and work placements are the essential link to make a graduate employable with the capability to work in industry.

There are a lot of good examples already at several colleges and companies of how successful work placements are happening, so the goal here should be to bring everybody (colleges and companies) up to the highest feasible level, and provide a meaningful experience for as many students as is possible.

There are some good examples of companies engaging with colleges and students to propose industry relevant projects for students to work on while in college. These might be final year projects (FYPs) or shorter projects that are part of individual modules (e.g. an analog circuit design or the design and synthesis of a digital function). Anecdotally, these examples are not common, so it is believed there is significant scope to expand what is happening in this area. From discussions with a few colleges, it is believed that they are open to engaging on this topic, although there are logistics that need to be worked out like timing, ensuring projects meet certain standards and guidelines, and avoidance of intellectual property (IP) ownership concerns.

It is suggested that a process for Work Placements and Project Work should include the following:

- Most companies in the sector (both MNC and SME) taking on students for work placements.
- Some guidelines and standards in place to ensure the best possible experience and outcome for the students (which will likely also be the case for the companies).
- Companies to engage with colleges on proposing industry relevant projects, and mentoring students on the projects where that is feasible. Role models can be important.
- An expected additional outcome should be that the electronics sector's brand is grown in a positive manner with the student population as a whole.

Suggested Action Plan:

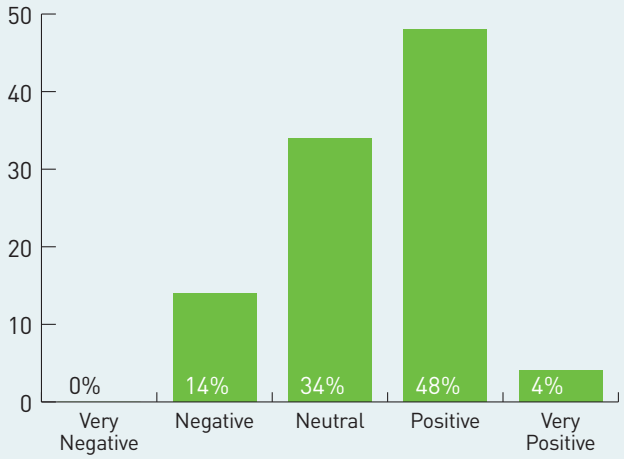
Initiate discussions with companies on putting together an improved level of support for Work Placements and Industry Relevant Project Work. It is suggested that forming a cross sector team to scope out the detail of what needs to be done and continue with implementation would be a good approach.

Action 2c
Step up Student Outreach and Engagement to build the brand of the Irish Electronics Sector with Students as an Attractive Sector in which to build their Career.

General Comments:

The electronics sector's image may be weak among students and graduates, as is evidenced by the response to Question 19 *(How do you believe a recent Electronic Engineering Graduate perceives the electronics sector as a career option?)* of the survey. While the overall response to this question might be seen as slightly positive, it is believed that it should be a lot more positive than this.

FIGURE 21 ▸ GRADUATE PERCEPTION



This suggests the following:

- Weak electronics sector recognition among students.
- The electronics sector not being as attractive as it could be as a career option.

There is a need to build the brand of the Irish electronics sector through improved student outreach, so that more students choose engineering and a higher percentage of those students see the sector as an attractive place to build their career. The survey, taking into account Question 19 and some comments in response to some other questions, suggested that this brand building needs be done at primary, secondary and third levels. There is also a need to promote the sector to female engineers to address the current gender imbalance in the sector (about 15% or one female to every six to seven males).

Promoting to third level should be very possible. Promoting to second level is a bit more challenging, but there are good examples of MIDAS and some of its member companies engaged with schools on the CanSat Project, Limerick for Engineering, etc. Some other individual companies are also doing some good second level promotion. Promoting to primary level and females is more challenging again, but should be part of an overall effort at improving of the sector image to all stakeholders (see also Action 4 on the Sector Image).

Suggested Action Plan:

MIDAS Ireland and its member companies should form a team or teams to coordinate and implement a reach out to students to tell them about the sector, career opportunities, etc, and build the brand. This needs to be done on an annual basis, as new classes of students come through. The collateral put together from Action 4 on the Sector Image can be used to promote the Electronics Sector as a great place for people to build their career.

One potential solution is to take a regional approach to student outreach, and have teams in multiple geographies around the country made up of engineers from companies in that region who engage with the third level colleges and secondary schools in their area. There may be potential to establish groups in the Dublin, Cork and Limerick / Galway areas. This may need a budget, to host events at schools and colleges, company visits, etc.

MIDAS Ireland has run a third level student competition for a number of years, which students can enter a project they have done, and which is sponsored annually by one of the leading electronics companies. The number of entries has sometimes been on the low side. This competition needs to be promoted more effectively to increase the visibility and participation rate from both students and colleges.

Increase participation in the CanSat project, Limerick for Engineering and any other similar initiatives to build the brand of the electronics sector at secondary school level. This likely needs to be done by Transition Year as students make Leaving Certificate subject choices at that point with future career choices in mind. Career guidance and other teachers, along with parents, also influence student decision making, so they also need to understand the career opportunities in electronics. More companies and more schools need to be involved in any secondary level outreach initiative.

Category 3: Resources – Increase the Talent Pool

Action 3a
Develop a plan on how to attract engineers with New Skills to work in the Electronics Sector. These engineers may already have the necessary skills (e.g. software engineers, data analytics) or need some re-training (e.g. physics, mathematics). Put the required CPD and re-training initiatives in place to support this process.

General Comments:

Responses to Question 25 *(In terms of an overall balanced future hiring strategy, what should be the % split across various sources of talent?)* of the survey suggested that the sector would like to have about 15% of its future hiring to be of people with new skills. From the leader interviews, it is understood that there is very little hiring from these sources happening today.

These hires would be either of engineers with the necessary skills (e.g. software or data analytics) to be able to take up a role and work immediately with little or no training beyond what a regular new hire might need, or engineers with some basic skillsets (e.g. physics, mathematics or software) that would need some introductory training to be able to take up a role in the sector.

Various issues to consider might be as follows:

- Define more clearly what new skills the sector needs to recruit.
- What educational background do the target engineers need to have?
- What roles could be filled in the electronics sector through this process?
- Where to find these people?
- Does the electronics sector look attractive to these people? Financially, career wise, etc?
- How to promote the electronics sector and its opportunities to these people?
- Is the promotion through recruiters, an advertising campaign or through some other means?
- How can any anti-competition issues be avoided to allow companies compete as normal on their own hiring activities, while working together to support the process?
- What CPD and training initiatives need to be in place to support these engineers re-training so they can move to the electronics sector?
- Is there a training initiative that could create a pool of available engineers to hire from?

Suggested Action Plan:

MIDAS Ireland and its member companies should form a cross sector team to scope out the detail of what needs to be done and continue with implementation.

The work done on the Sector Image under Action 4 will be critically important to support this action.

Action 3b
Increase hiring into Ireland from abroad (currently at ~35%) to increase the available talent pool and minimize loss of R&D positions to other countries. Put support in place to assist people with the logistical challenges of moving, and for companies to make the process easier.

General Comments:

In the Question 22 *(Has your Company opened an R&D Centre elsewhere due to resource shortages in Ireland?)* of the survey, 50% of companies said they had opened an R&D centre in another country, to support their Irish operation, due to not being able to find the engineers to hire in Ireland. The SMEs gave specific numbers on jobs lost, in total 168, and the MNC respondents gave vaguer answers and people from within the same company offered different answers in some cases, but overall it is estimated that at least 1,000 R&D positions have been lost to Ireland due to not having a big enough pool to hire from. This is quite a high number when compared to the overall 3,000 R&D positions currently within the sector.

In discussions, some people have asked if non-availability of a particular skill was a contributing factor, but questioning some of the companies that have opened R&D centres in other countries, they are not saying this was a

primary reason behind their decision. Financial benefits due to having a team based in a lower cost location was also not quoted as a primary reason, even though a few commented that this was a positive side benefit.

Companies in most cases said they would prefer to have these teams located in Ireland, if they could find sufficient local talent.

It seems like the only way to reverse the trend is to increase the overall pool of talent available to the electronics sector in Ireland, and there are only three ways to do this:

1. Increase the supply of graduates coming into the sector.
2. Increase hiring of engineers with new skills.
3. Increase hiring from abroad into Ireland.

Items 1 & 2 are being addressed by other actions and are unlikely to be sufficient, so it is logical that hiring from abroad needs to be continued and increased from its current level of around 100 per year to maybe 150 - 200 per year.

Hiring from elsewhere in the EU may be more desirable than outside the EU for several reasons, but it is believed that salary structures in Ireland with the sector may be mitigating against this. Ways need to be found to present the value proposition of the Irish electronics sector, financial, quality of life, etc, to potential hires from elsewhere in the EU. The work done on the Sector Image under Action 4 will be critically important in this regard.

Part of the work to support this recommendation needs to be around the logistics and challenges associated with moving to Ireland. These range from work permits, the finding and the cost of accommodation (purchase or rental), getting set up with bank accounts, GPs, schools, etc.

Suggested Action Plan:

MIDAS Ireland and its member companies should form a cross sector team to scope out the detail of what needs to be done to increase hiring from abroad and continue with implementation.

The work done on the Sector Image under Action 4 will be critically important to support this action.

Category 4: Sector Image

Action 4
Promote the Electronics Sector as a great place for people to build their career. This includes promoting Engineering as a Profession, Electronics' positive contribution to society's needs, as well as highlighting the financial attractiveness of the sector.

General Comments:

There is a need to improve the image of the Electronics sector and in particular to promote it as a great place for people to build their career.

At this point in time, the sector does not put a big effort into self-promotion or telling its story. While people are generally aware of electronic gadgets like computers and phones, and services like the internet and television, the story of how electronics is central to the make-up and delivery of all of these is not well told. Also, the extent and scale of the electronics sector's imprint in Ireland is almost a well-kept secret.

This hurts the sector in many areas, but in particular in terms of building its brand as a great place to work. This image needs to be built up and established with several stakeholders, including parents and their children, students at second and third level, teachers and college lecturers, as well as state agencies and government departments, including government ministers.

There is a very strong economic story to be told which includes most of the world's leading electronics companies having R&D teams and operations in Ireland, many successful local SMEs, about 20,000 jobs, a very high percentage of which are in highly skilled technical roles. The sector contributes about €13.5B per annum to Irish GDP.[2]

The level of R&D activity within the sector in Ireland compares very favourably with that going on in any other country or region around the world and this has grown from experience built up over almost 50 years since the industry started in Ireland during the 1970's.

The most important story that needs to be told however is how electronics is key to technologies which are addressing society's greatest challenges, from climate change to healthcare, future sustainable transport, how we live & work, etc. This list goes on and on. How many people

2 MIDAS Brochure

know that electronics is the key enabler to solving climate change challenges, that electronics is central to future electric and autonomous vehicles, that electronics is key to future advanced healthcare solutions, that electronics is key to communications & entertainment technologies, that data analytics / artificial intelligence / machine learning are becoming more becoming key components of the electronics story, and that leading edge R&D to support all these areas is happening in Ireland today?

Increasingly, young people are making career decisions based on how they can contribute in a positive manner to the great challenges that the world we all live in faces. They are attracted to careers in medicine, teaching, social services, etc – 'the caring professions'. This is especially true of females. Electronics needs to establish itself alongside these career options, as a career that is caring and good. This is a challenge for the sector that it is well capable of addressing.

Electronics needs to be demystified and not seen as a 'black art' that only the smartest people can understand. Yes, it is technically challenging, but all worthwhile roles are challenging. If you ask a doctor, a nurse a teacher or a lawyer about their jobs, I am sure they will also list the challenges, but the rewards and job satisfaction are there to compensate and provide return for their efforts. Electronics needs to position itself as a rewarding career that is within reach of smart, caring and ambitious people.

The sector is also financially rewarding. This is true from the most highly valued companies in the world (Apple, Amazon, Google, Microsoft, Intel, Tesla, etc) being technology companies (technology is built on the electronics) to the financial rewards that employees take home each month / year during their careers. Electronics companies have been in Ireland for almost 50 years, and the financial rewards that people who have worked and built their careers in the sector have received compare favourably to any other sector during that period. An example quoted was that the medical sector promotes the financial rewards for a Consultant – electronics needs to do the same for a CTO or senior engineering leader. The sector needs to position itself as offering a financially rewarding career and not compete only on a graduate's salary during the first year, although that is also important.

Another issue that should be addressed is the profile of engineering as a profession and the value of the engineering title. Up to now the electronics sector has not put much formal value on engineering titles in Ireland. That would also be true of some other countries like the UK. There is the sense that this somehow devalues engineering as a profession in the eyes of the public, and for those that are looking at engineering, and specifically electronic engineering, as a career option.

Other professions in Ireland like Law and Medicine put a strong value on titles and this is linked to their ability to practice. This is also the case for Civil Engineers who need to have Chartered (CEng) status to sign off on their work, e.g. building regulations.

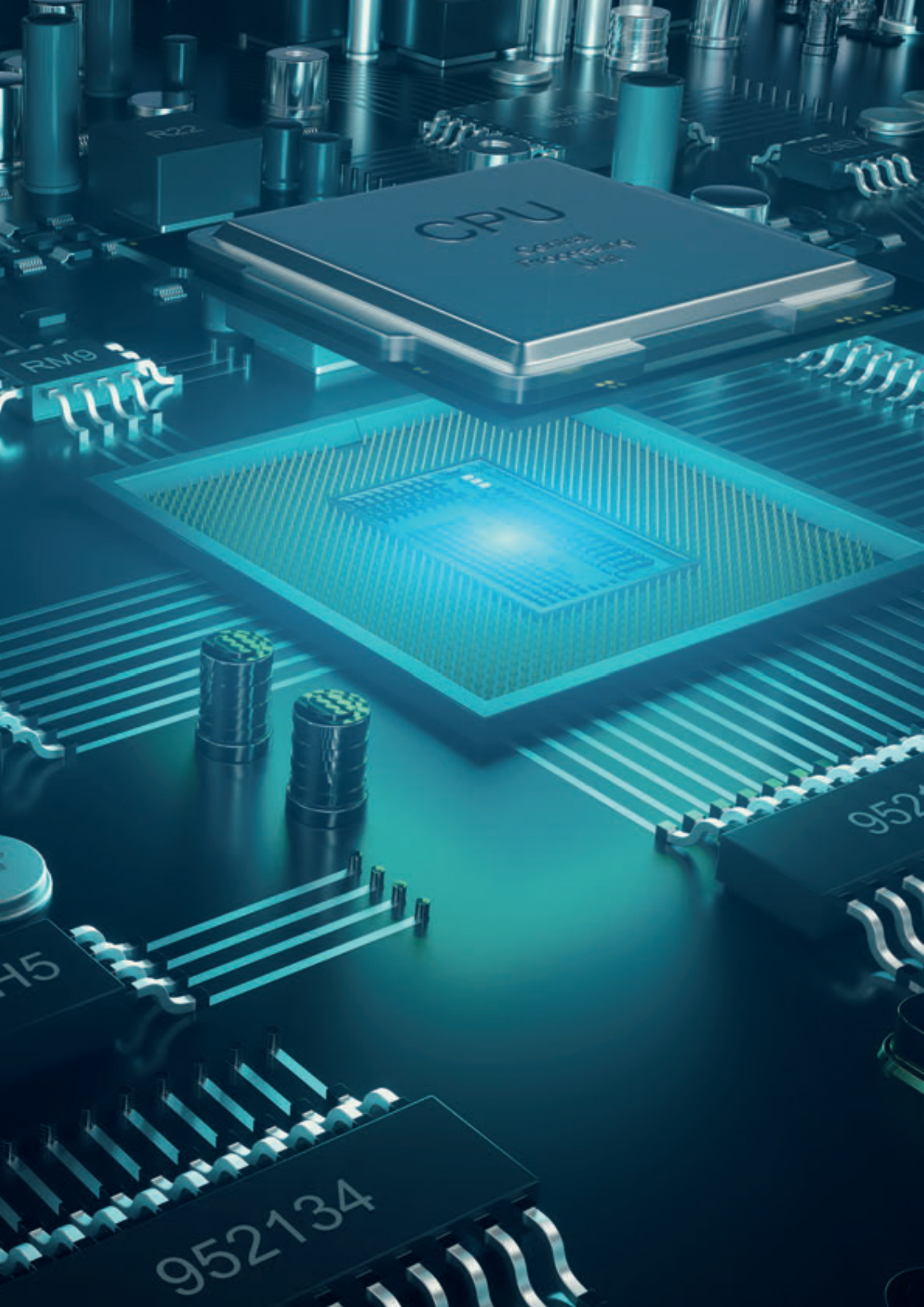
Will electronics need to evolve how it views titles in future, especially as electronics content increases in more regulated areas like automotive and healthcare, and would this actually be a positive thing in terms of raising the image of the sector? In other countries like Germany there is much higher professional recognition and protection for engineering qualifications - for example no one except a fully accredited engineer can call themselves an "engineer". This increases respect and kudos for the engineering profession and therefore helps with recruitment and retention.

Suggested Action Plan:

Find ways to tell the electronics sector story.

This could include but is not necessarily limited to the following:

- A powerpoint slide deck that is available to everybody in the sector to use to tell the sector story at every opportunity.
- Find the stories to tell that people can relate to.
- Videos showing examples of electronics technology addressing societal challenges and Irish engineers' role in developing these technologies, which are readily available on the MIDAS Ireland website, and through social media channels.
- Reaching out to schools (primary and second level) and colleges to get in front of students. (See also Action 2c on Student Outreach and Engagement and how this Action on Sector Image supports that.) Teachers and college lecturers need to be told the sector story too.
- Use the Sector Image story to attract engineers with new skills (Action 3a) and from abroad (Action 3b) to work in the Irish Electronics Sector.
- Consider publicity campaigns on social media, national TV/radio, print and online media, etc.
- Tell the sector story to stakeholders in state agencies, government, etc.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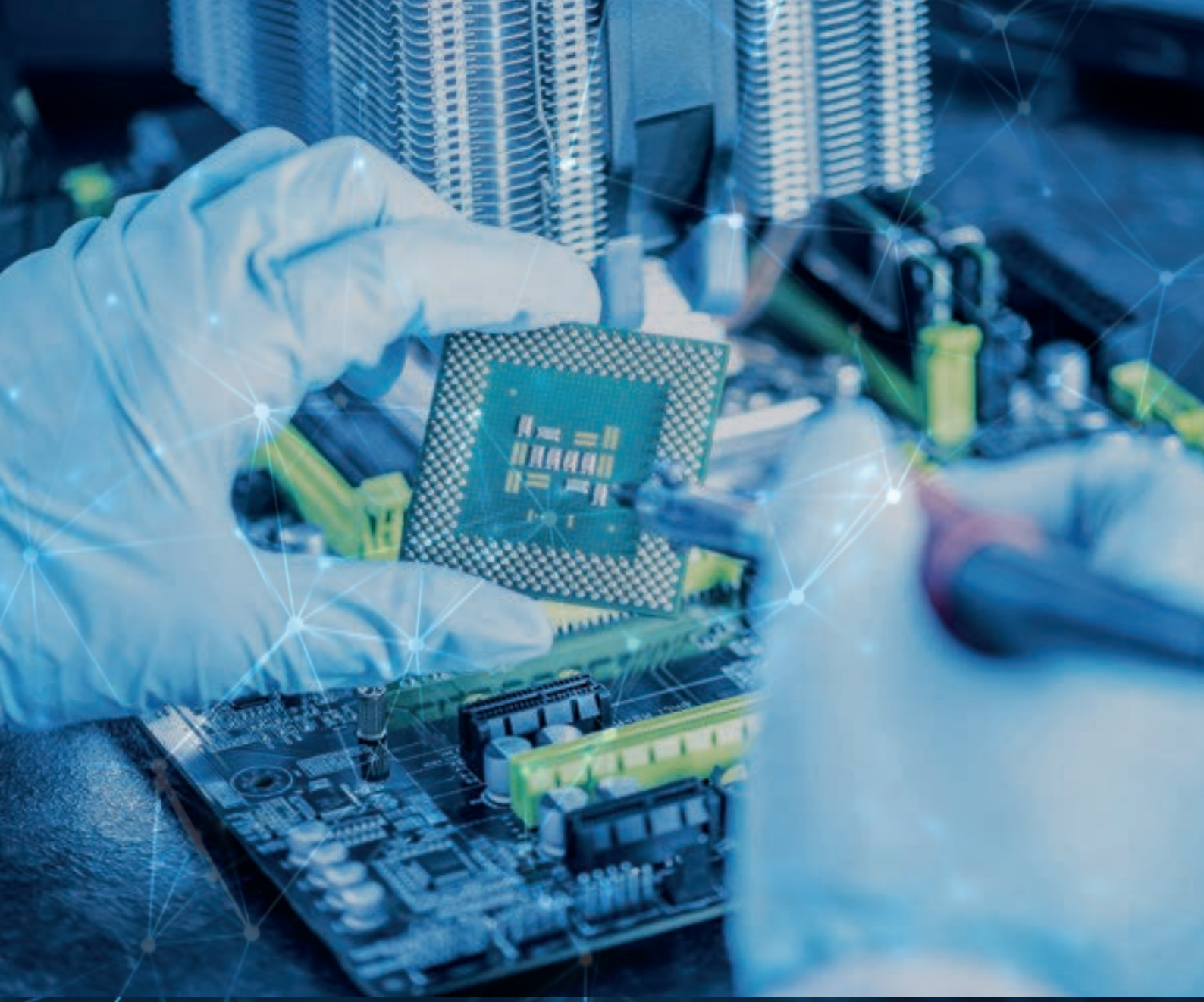
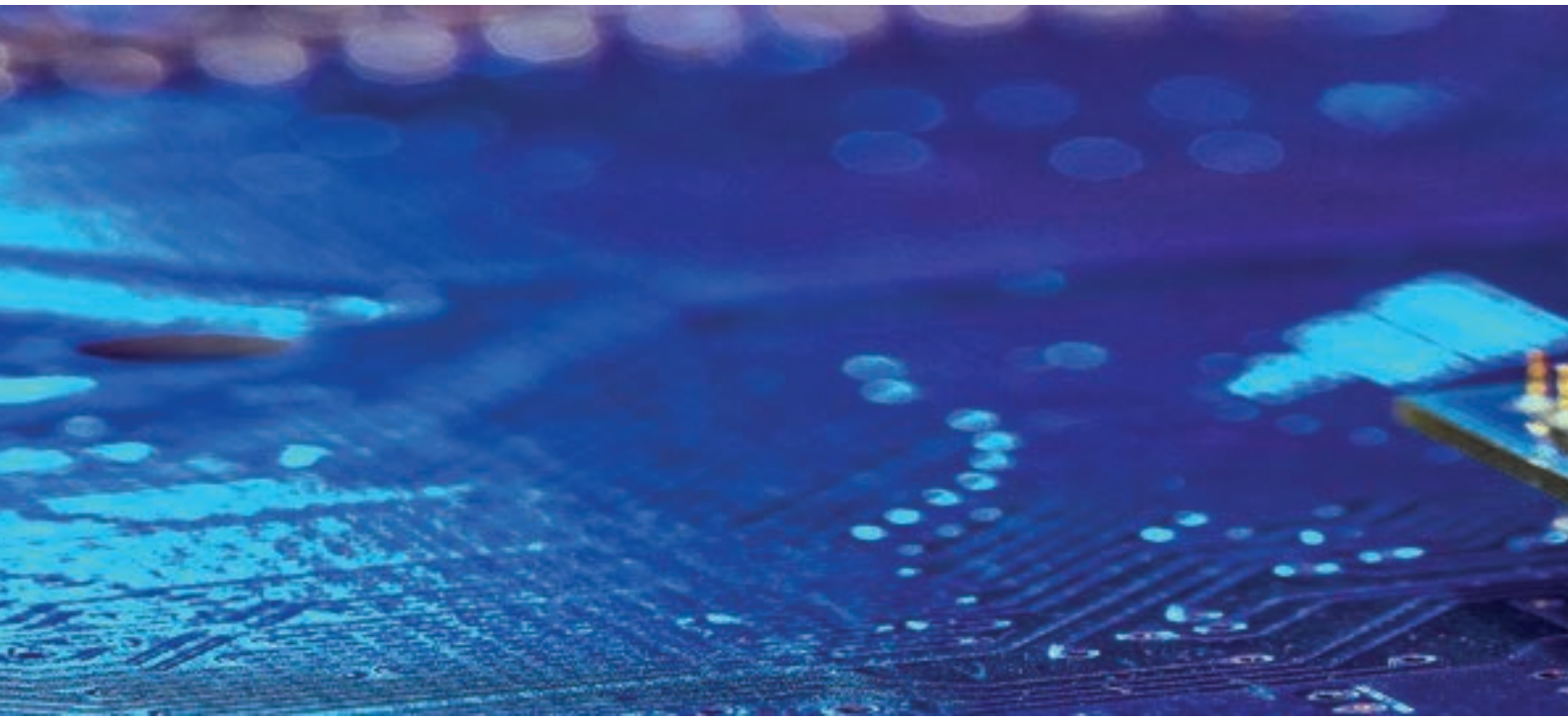


chapter **SIX**

Conclusion



Conclusion

The electronics sector in Ireland employs about 20,000 people, with about 6,500 of the jobs in highly skilled technical roles and about 3,000 of these in world-class research and development (R&D).

This is a fast moving segment with technology advancing continually, so there is a need to be constantly upskilling the workforce.

In common with many other high technology segments in Ireland, there is a constant demand for more highly skilled people to fill new positions as they come on stream. The sector hires more than 100 college graduates every year, and does about one third of its hiring from abroad, but that isn't enough to keep up with demand. It is estimated that over 1,000 R&D jobs have been lost to other countries during the past several years due to a lack of sufficient resources available to hire in Ireland.

During this project, a comprehensive study was done to understand the future resource and skills needs for the electronics sector in Ireland. A detailed survey went to almost 70 companies. This was followed by one-on-one interviews with over 20 leaders in those companies to understand the results from the survey in more detail. Discussions then took place with representatives from universities and institutes of technology to share the results of the survey with them and understand their views on educating the graduates that the sector hires.

The project produced a number of informative findings, which lead to nine proposed recommendations that the sector can move forward with and implement to improve the future environment as regards skills and resources.

There recommendations are summarised again as follows:

Category 1: Skills / Training

1a. Continue to offer Short Training Courses in support of the needs of the Companies.

1b. Develop new CPD Modules in support of the needs of the Companies.
Explore how a path to a formal Educational Qualification (e.g. Masters) can be put in place.

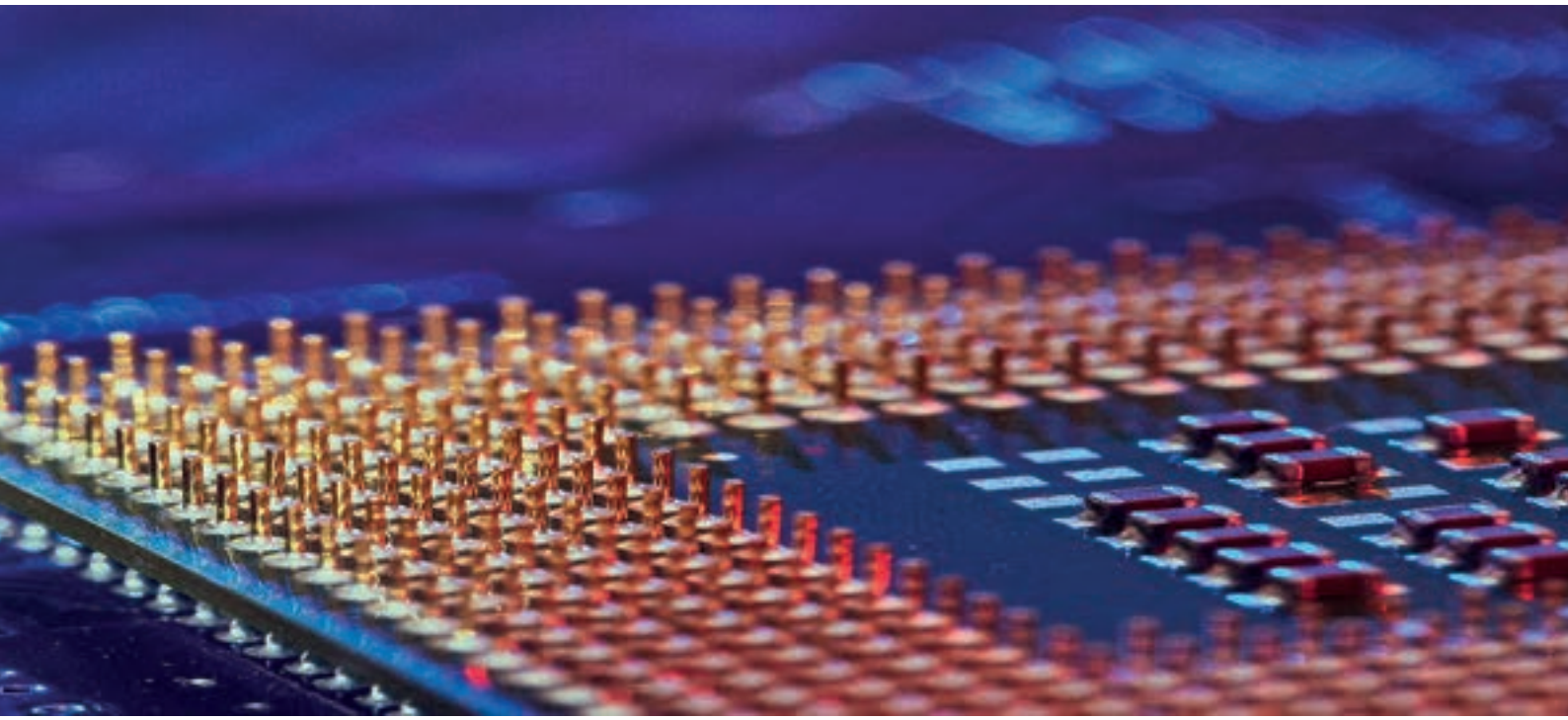
1c. Develop a plan for and put in place Soft Skills Training for the Electronics Sector Employees.

Category 2: Resources - Graduates

2a. Put in place a process with the Irish Colleges to discuss course content and optimum learning styles to support the Electronics Sector's future needs.

Investigate if an apprenticeship programme can be put in place to help increase the supply of Level 7's (Technicians).

The ultimate goal is to increase the pool of graduates available to the sector for hiring at the various educational levels.



2b. Companies to engage with colleges and improve support for Work Placements and Industry Relevant Project Work aligned with future skill needs and with optimum Graduate Learning Styles.

2c. Step up Student Outreach and Engagement to build the brand of the Irish Electronics Sector with students as an attractive sector in which to build their career.

Category 3: Resources – Increase the Talent Pool

3a. Develop a plan on how to attract engineers with New Skills to work in the Electronics Sector.

These engineers may already have the necessary skills (e.g. software engineers, data analytics) or need some re-training (e.g. physics, mathematics).

Put the required CPD and re-training initiatives in place to support this process.

3b. Increase hiring into Ireland from abroad (currently at ~35%) to increase the available talent pool and minimize loss of R&D positions to other countries.

Put support in place to assist people with the logistical challenges of moving, and for companies to make the process easier.

Category 4: Sector Image

4. Promote the Electronics Sector as a great place for people to build their career.

This includes promoting Engineering as a Profession, Electronics' positive contribution to society's needs, as well as highlighting the financial attractiveness of the sector.

It is hoped that the sector can actively adopt these recommendations and support them to the degree that is necessary to produce the desired results. It is the view of the author of this report that this support is critical, and without it nothing of value will change.

The electronics sector in Ireland, both on the industrial and academic sides, is compromised of excellent people and talent everywhere one looks. However, the sector can benefit from more collective thinking and cooperation on the common challenges, to address major issues like the future resource and skills needs for the sector.

Significant improvements can be made in these areas, but real collective action is needed.

Appendices

Appendix 1

List of Companies included in the Survey

The companies included in the survey were all MIDAS Ireland members, some other companies suggested by Enterprise Ireland and some companies that are active in the MIDAS Electronics Systems Skillnet.

Abrel Products	SME
Acetech Solutions (ATSR) Ltd	SME
Advanced Energy	MNC
Altratech	SME
Analog Devices	MNC
Anatech Silicon	SME
Anecto Ltd	SME
ARM Ireland Ltd	MNC
Arralis Ltd	SME
Benetel	SME
Black Box	SME
Cadence Design Systems	MNC
Ceva-DSP	MNC
Chipright Ltd	SME
CreVinn Teoranta	SME
CW Applied Technology	SME
Cypress Semiconductor Ireland	MNC
Dell EMC	MNC
Dialog Semiconductor	MNC
Easy IC	SME
Eblana Photonics	SME
Emdalo Technologies Ltd	SME
Emutex Ltd	SME
Endura Technologies	SME
Equal One	SME
Farran Technology	SME
Firecomms	SME
FMG Electronics Ltd	SME
Hannah Moore & Curley	SME
HDMS – Gerard Henry	SME
Hi-Silicon – Huawei	MNC
ICERGi Ltd	SME
IC Mask Design	SME
IMEX Instruments Ltd	MNC
Infineon	MNC
Innalabs	SME
Intel Ireland	MNC
Jaguar Landrover	MNC
Litho Circuits Ltd	SME
M/A-Com	SME
Maxim Integrated	MNC
Mbryonics Ltd	SME
Memjet Technology Ltd	SME
Microchip	MNC
Mint Tek Ltd	SME
Mobica	SME
MSemicon Teoranta	SME
O'Carroll BizDev	SME
ON Semiconductor	MNC
OTC Ireland	SME
Parade Technologies Cork	MNC
Pilot Photonics Ltd	SME
Qualcomm	MNC
Qorvo (Decawave Ltd)	MNC
Reivr Fusion	SME
SDC Business Consulting Ltd	SME
Shimmer Research	SME
Synopsys	MNC
Tisa Labs	SME
Taoglas Ltd	SME
Tekelek Europe Ltd	SME
Toorane Technology	SME
U-Blox Cork Ltd	MNC
Vishay Siliconix Ireland	MNC
Vitalograph Ireland	SME
Western Automation	SME
Xilinx Ireland	MNC
yieldHub	SME

Appendix 2

List of Company Interviewees

Company	Name	Position
Analog Devices	Mark Barry	General Manager
Analog Devices	Eileen Liston	Human Resources Director
Analog Devices	Mike Mulqueen	Engineering Director
Analog Devices	John Quill	Engineering Director
Dialog Semiconductor	Dermot Barry	General Manager
ARM Ireland Ltd	Mike Lardner	General Manager
Black Box	John Hickey	General Manager
Easy IC	Fearghal Hannaway	General Manager
Emdalo Technologies Ltd	Daire McNamara	General Manager
Emutex	John Twomey	General Manager
IC Mask Design	Fergal Brosnan	General Manager
Infineon / Cypress	Martin O'Keeffe	Engineering Director
Intel Ireland	Mary Finegan	Engineering Director
Intel Ireland	Noel Murphy	General Manager
Intel Ireland	Ronan O'Ceallaigh	Engineering Director
Microchip	Con Cremin	Engineering Director
ON Semiconductor	Damien Walsh	General Manager
Qualcomm	Paul Kelleher	General Manager
Reivr Fusion	Joe Moore	General Manager
Synopsys	Peter Gillen	General Manager
U-Blox Cork Ltd	Jim Connelly	General Manager
Xilinx Ireland	Oleh Krutko	Engineering Director

Appendix 3

List of Academic / Training Interviewees

College / Organization	Name	Position
Carlow Institute of Technology	Cathal Nolan	Engineering Department Head
Carlow Institute of Technology	James Garland	Member of Academic Staff
Carlow Institute of Technology	Vincent O'Brien	Member of Academic Staff
Cork Institute of Technology	Martin Hill	Engineering Department Head
Cork Institute of Technology	John Horan	Member of Academic Staff
Cork Institute of Technology	Paddy Collins	Member of Academic Staff
Harrier IC	Mark Smyth	MIDAS CPD Module Champion
Limerick Institute of Technology	Maura Clancy	Engineering Department Head
Limerick Institute of Technology	Seamus Faul	Member of Academic Staff
Limerick Institute of Technology	Keith Moloney	Member of Academic Staff
Limerick Institute of Technology	Paul Morrow	Member of Academic Staff
Microelectronics Circuit Centre Ireland	Donnacha O'Riordan	Executive Director
Premier Coaching Solutions	JJ O'Riordan	Executive Coach, Soft Skills Trainer
Quality & Qualifications Ireland	Colette Harrison	Manager of Awards & Certification
Technical University Dublin	Dick Gahan	Member of Academic Staff
Trinity College Dublin	Anil Kokaram	Engineering Department Head
University College Cork	Emanuel Popovici	Member of Academic Staff
University College Dublin	Peter Kennedy	Engineering Department Head
University of Limerick	Martin Hayes	Engineering Department Head
University of Limerick	John Nelson	Member of Academic Staff
Waterford Institute of Technology	Ken Deevy	Member of Academic Staff

Appendix 4

Other Stakeholders Consulted during the Project

IDA Ireland

- Leo Clancy, Head of Technology, Consumer and Business Services
- Donal Travers, Technology Director
- Tara O'Mahony, Client Relationship Manager - Technology

Enterprise Ireland

- Alan Dunne, Senior Development Advisor - Electronics

MIDAS Ireland General Manager and Directors

- Leonard Hobbs, General Manager
- John Quill, Company Secretary and Director
- Damien Walsh, Director
- Joe Moore, Director

MIDAS Ireland Advisory Board

- John Quill, Analog Devices
- Damien Walsh, ON Semiconductor
- Joe Moore, Reivr Fusion Ltd
- Patricia Moore, Mindseed
- Noel Murphy, Intel
- Sean Foley, Infineon
- Donnacha O'Riordan, MCCI

MIDAS Electronic Systems Skillnet Manager and Steering Group

- Damien Walsh, Network Promoter
- Gerry Byrne, Network Manager
- Kieran Burke, Intel
- Chris Campbell, Dialog Semiconductor
- Avi Caspi, Synopsys
- Ray Goggin, Analog Devices
- Peng Lim, Xilinx
- Martin O'Keeffe, Infineon / Cypress
- Manu Prakash, Qualcomm

Appendix 5

Acronyms and Definitions

AI	Artificial Intelligence
AR	Augmented Reality
BERD	Business Expenditure on Research and Development
BI	Power BI - Business Analytics Service by Microsoft
CanSat	Student competition to design, build and test a mini-satellite
CEng	Chartered Engineer
CPD	Continuing Professional Development
CPU	Central Processing Unit
CTO	Chief Technology Officer
DMAIC	Define, Measure, Analyze, Improve and Control
DSP	Digital Signal Processing
ECTS	European Credit Transfer and Accumulation System
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
EU	European Union
EV	Electric Vehicle
FinFET	Field Effect Transistor where the Gate is wrapped around the Channel
FPGA	Field Programmable Gate Array
FYP	Final Year Project
GaN	Gallium Nitride
GP	General Medical Practitioner
HCI	Human Capital Initiative
HEA	Higher Education Authority
HW	Hardware
IDA	Investment Development Agency
IoT	Institute of Technology
IoT	Internet of Things
IP	Intellectual Property
IT	Information Technology
MCCI	Microelectronics Circuit Centre Ireland – www.mcci.ie
MIDAS	Microelectronics Industry Design Association – www.midasireland.ie
ML	Machine Learning
MNC	Multi National Corporation
NFQ	National Framework of Qualifications
P&R	Integrated Circuit Digital Place and Route Layout
QQI	Quality & Qualifications Ireland
R&D	Research and Development
RF	Radio Frequency
RTL	Register Transistor Logic
Si	Silicon
SiC	Silicon Carbide
SME	Small to Medium Enterprise
SoC	System on Chip
SW	Software
UVM	Universal Verification Methodology

Appendix 6

Reference Documents & Bibliography

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About the Authors

MIDAS Ireland

MIDAS Ireland www.midasireland.ie is an industry led cluster consisting of industry, educational, research and government agencies, working together to assist in the development of the 'micro and nano-electronics based systems sector' in Ireland. MIDAS began in 1999 and its aim is to represent the entire value chain, as the industry evolves to deliver combined electronic and software system solutions. MIDAS is a member of Silicon Europe which is an alliance of Europe's leading microelectronics and nano-electronics clusters. MIDAS is the key enabler of networking opportunities that develop in our industry, as well as enhancing the training of graduates and professional engineers; to make it one of the best industry sectors to work in.

John Blake

John Blake is an experienced electronics industry executive who spent his 34 year career working in senior engineering and business leadership positions with Analog Devices and ON Semiconductor, while based in Ireland, the UK and the USA. His most recent position was as R&D Site Director for ON Semiconductor's Design Centre in Raheen, Limerick, which focuses on developing advanced power management solutions and grew from about 25 engineers to about 75 engineers under his leadership between 2008 and 2019. John left this role in April 2019 and is now working part-time as a consultant on projects in the technology area. He served as Chairman of MIDAS Ireland for 5 years from 2011 to 2015.

MIDAS Electronics Systems Skillnet

The MIDAS Electronic Systems Skillnet www.midasireland.ie/skillnet is a collaboration between semiconductor and electronic system companies based in Ireland to meet their mutual need of world class cost effective training held locally for skilled employees in the sector.

MIDAS Electronic Systems

Skillnet

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MIDAS IRELAND

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An Roinn Oideachais agus Scileanna
Department of Education and Skills

Skillnet IRELAND