Compound Semiconductor Skills Survey

FINAL REPORT

July 2018

"Skills are a priority for businesses because they are central to adding value – in leadership, management, production processes and innovation, enabling the introduction of new technology and knowledge transfer. The best performing businesses are those which are highly innovative, quickly adopting new technology or innovating themselves – in their products and processes as well as in business and management practices."

Neil Carberry, Managing Director, CBI

"What we are trying to achieve here is South Wales will be unique. It's an opportunity, not only for Wales but for the UK and Europe"

Drew Nelson, CEO, IQE

**UK Electronics
Skills Foundation**

Contents

Introduction

As noted in a recent report by the CBI (CBI, 2017) skills are critical, yet we struggle to get provision right. They are central to an effective, national industrial strategy. For the UK to maintain its position as a leading global economy, investment in people's skills is essential.

There is a growing Compound Semiconductor (CS) Cluster in South Wales, which currently directly employs around 1,500 people and is set to see significant growth.[1] These are high value jobs at the start of the semiconductor supply chain and demand is expected to grow significantly over the next five or so years. There are expectations that the UK will be at the fore of a global compound semiconductor market predicted to be worth $140bn by 2023. However, it is a highly technical sector with some very specific skills sets.

In order that the Cluster can grow and flourish as an area of expertise in this global industry sector, it is essential to ensure that the appropriate educational and training capabilities are in place. These are required to support the anticipated growth and to attract more talent and inward investment.

Objective

The objective for the UKESF has been to produce an independent report that identifies the future education and skills requirements to support the success and growth of the Cluster. In order to produce the report, we have gathered evidence through an online survey and in-depth interviews with key stakeholders from industry, NGOs and academia.

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[1] At the core of the Cluster is CS Connected. This consists of the Institute for CS, the CS Centre and the CS Applications Catapult. There are four principal business partners: IQE, MicroSemi, Newport Wafer Fab and SPTS. The supply chain partners are: Airbus, GD UK and GE Healthcare.

Context

In November 2017, the Government published a new Industrial Strategy. This long-term plan aims to boost productivity and earning power throughout the UK with investment in skills, industries and infrastructure of the future. The Strategy states:

> *"The world is undergoing a technological revolution. Artificial intelligence (AI) will transform the way we live and work … This fourth revolution [also known as Industry 4.0] is of a scale, speed and complexity that is unprecedented … blurring the lines between the physical, digital and biological worlds. It will disrupt nearly every sector … The UK is already a world leader in AI … UK innovators push boundaries in robotics and the internet of things.*"

The Industrial Strategy also highlights the importance of improving intra-city transport and creating faster links between cities. AI, robotics and transportation are picked out in the strategy as key areas for focus and investment, and all are dependent on Electronics. As the strategy explains, its success will "depend on our ability to keep up with the pace with new sectors and emerging businesses". For this to happen, a higher number of young people will need to study Electronics at university.

The UK has a long heritage of technological innovation and has a world-class Electronics sector. However, there is a fundamental problem for the UK. Our participation in and leadership of these technological advances is being limited by a chronic skills shortage in Electronic Engineering. Over a number of years, too few students have been studying Electrical and Electronic Engineering. This, in combination with an ageing workforce, means that there are insufficient graduate engineers to drive forward innovation and progress. This situation is likely to worsen post-Brexit. The shortage is also exacerbated by a fragmented landscape across the sector. Ultimately, this will undermine the Electronics sector as a whole in the UK, which in turn, will adversely our economic prosperity.

The UK Electronics sector is a world-leader and one of the keys to the success of the UK economy. Engineering contributed £455.6 billion to the UK's economy in 2014. The Gross Value Added (GVA) of engineering businesses was more than retail, wholesale, financial and insurance sectors combined (Engineering UK, 2017). Within engineering, the Electronic and Electrical Engineering sub-sector contributed more than any other did (GVA £131 billion) and employed 1.5 million people (Engineering UK, 2016, p.23). The market for compound semiconductors has rapidly expanded and is estimated to be worth £66 billion; the UK has a current market share of around 9%.

Electronics is a sector that is continuing to grow and the demand for graduates is outstripping supply. Overall, only 3,330 UK students enrolled on first degrees in Electronic and Electrical Engineering in 2017, which is less than half the number enrolling on Mechanical Engineering degrees (UCAS, 2017). Approximately 22% of employers in this sector have reported problems in recruiting engineering graduates (The IET, 2016). A survey conducted by the CBI revealed that 46% of employers reported a shortage of STEM graduates (Engineering UK, 2016, p.262).

Findings

Preamble

This report provides some key themes from evidence gathered through a series of in-depth, structured, telephone interviews with some key stakeholders. A locally based, highly experienced, journalist has undertaken these interviews.[2]

As noted in the Introduction, the CS Cluster has only a small number of core partners and, as a whole, the CS sector is relatively small. Nevertheless, over 20 stakeholders and potential partner organisations were interviewed and their views are reflected in this report. As well as the core CS Cluster partners, they included a number of different commercial companies and Higher Education Institutions. This range reflects the disparate and wide nature of those involved with compound semiconductors through the Cluster. Transcripts from these interviews have been included at Appendix 2. In addition, we have augmented the evidence collected through the interview with data from an online survey of stakeholders (16) from the wider CS community who had not been interviewed. The full results from the online survey are included at Appendix 3.

Headlines

These are the main headlines from our research:

- There was a lot of positivity surrounding the potential for growth within the CS Cluster but there were significant concerns about sourcing sufficient additional, skilled, staff at all levels to meet the future demand.

- It was widely acknowledged that there are few, if any, 'ready-made' potential employees for the CS Cluster; upskilling and re-training are required for all new recruits.

- The likely retirement of older staff over the next decade means that sustainability is a genuine and immediate concern for companies; recruitment has to increase over the next five years just to maintain capability, let alone meet future growth plans.

- Furthermore, the future growth for high-value jobs within the CS Cluster core partners is forecasted to be high; almost a thousand (939) additional jobs are likely to be created by 2024.

- Therefore, there is a need to take a more strategic approach, across the CS Cluster, in order to create a 10–12 year pipeline of 'talent' to address both the skills shortages and skills gaps.

- Employers were positive about apprenticeship schemes. However, employers would encourage providers to offer a whole range of more flexible and modular-based training courses, not just for apprenticeships.

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[2] Nick Flaherty. He is one of the UK's leading technology journalists with over 25 years in the business as a writer, editor, consultant and media trainer. In that time he has edited a wide range of magazines, blogs and newsletters across the spectrum of technology, from silicon to automotive, providing clear, detailed and informed content, from news to industry comment. He is currently power editor for *EEnews Europe* and Technology editor for *Unmanned Systems Technology* magazine.

- Employers have some specific skills gaps; these include wafer level testing, characterisation and software.

- Employers saw the future demand for engineering staff educated to Level 8 (PhD) as high; plans for the Centre for Doctoral Training were welcomed, particularly the collaboration with industry. However, some doubts remained that demand at both Level 7 and Level 8 may still exceed supply.

Future Growth & Skills Demand

Interviewees were optimistic about future growth prospects for the CS Cluster and identified a number of areas where they considered that there was the prospect of significant growth. These included a wide range of application areas, including power (consumer, automotive, industrial), RF (4G, 5G telecoms, radar, sensors) and optoelectronics (VCSEL, fibre, sensors), as well as across multiple substrates (Si, diamond, GaN, GaAs, SiC) and multiple materials (GaN, SiC, GaAs). Some interviewees also identified possible applications for compound semiconductors in the healthcare arena. This positive sentiment was echoed by the survey results; 14 out of 16 respondents said that their organisation had plans to recruit engineering staff in the next 12 months.

Therefore, we have attempted to quantify the potential for future jobs growth within the core partners of the CS Cluster. Our forecast for this future jobs growth is shown in full at Appendix 1. The methodology we used for making the forecast was to take the stated 3-year business projections from interviewees and then combine these with some longer terms forecasts. Clearly, beyond the 3-year business plan horizon, there is a degree of uncertainty. For instance, the figures for years 4–6 would depend upon the successes and deals achieved in years 1–3. Nevertheless, from this analysis, we are forecasting that almost a thousand (939) additional high-value jobs could be created within the core partners of CS Cluster by 2024.

Skills Shortages

Although growth is the driver of increased demand for skills; however, it is not the principal reason for recruitment, at least not in the short term. The principal reason is sustainability. The retirement of older staff means that recruitment has to increase over the next five years just to maintain capability, let alone support the forecasted growth. The consensus of interviewees is that at least half the employees of their organisations, if not more, are likely to retire in the next ten to 15 years. Moreover, it generally agreed that it would take at least five years to get the majority of new employees fully competent. Therefore, this is creating a real a sense of urgency about tackling the skills shortages.

> *"We are going to have to run fast to stay still and even faster to make any ground – we are not the only country in the world looking at CS through all the applications.*
>
> CSC, Cardiff

Overall, almost two thirds (10 out of 16) of survey respondents reported that they had already experienced a skills shortage[3] within the last 12 months. It is particularly noteworthy that the most serious problems companies experience when recruiting is for positions requiring higher degrees (post graduate degrees or PhDs); we found that 6 out of 16 respondents said that they 'very often' had

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[3] A skills shortage is defined as 'an Engineering or Technology vacancy that has remained unfilled for at least 3 months due to the lack of a candidate with the required skill set' (Annual Skills and Demand Survey, The IET).

problems, whilst almost a fifth (3 out of 16) said that they 'always' had problems due to shortages when recruiting post graduates.

Skills Gaps

As well as a shortage of staff, there were significant concerns about particular skills gaps. In general, a substantial majority of survey respondents (12 out of 16) reported that 'lack of depth of technical knowledge' was the biggest problem when recruiting new staff. Indeed, 7 out of 16 reported that new starters lacked a knowledge of compound semiconductors, whilst over two thirds (11 out of 16) cited lack of practical experience of compound semiconductors as a concern.

In terms of specific technical gaps, interviewees identified wafer level testing as a key skill that is currently lacking. Testing is important for fabless companies but differs from silicon functional testing of large chips, as the compound semiconductor devices proposed are simpler and less integrated. Therefore, characterisation is more important but will become a bottleneck for high volume production. Whilst there are plans to expand the testing infrastructure with the Cluster, the absence of skills in this area is seen as a problem.

Another skills shortage associated with volume production of compound semiconductor chips is software. Interviewees considered that engineers with knowledge of software (for modelling, characterisation and test of CS devices) are in short supply and will become another bottleneck for manufacturers.

Skills Solutions

Those interviewed all recognised that there are no 'ready-made' employees for the CS Cluster, citing the relative newness of the sector as a specific recruitment challenge. New recruits either have silicon skills and, therefore, need specific compound semiconductor training, or have compound semiconductor skills but still need training in volume tools and processes (for instance, in the cleanroom environment or in packaging).

> *"We have got to train our own people and create a talent pool in Caldicott as looking outside there's nothing out there. It is quite scary the skills shortage – the average age is 46, 47 – there's a big void to the younger age group."*
>
> MicroSemi

In the short term, it was felt that some recruitment was possible from Scotland with the closure of fabs (e.g. TI/National Semiconductor, Motorola/Freescale/NXP); however, it was acknowledged that these silicon engineers would need re-training. This re-training would require a mixture of in-house and externally provided courses.

There had also been some limited success in addressing the skills shortages by recruiting engineers from overseas (e.g. from Singapore). However, respondents did not consider this to be a sustainable, long-term, solution for a number of economic and financial reasons. In terms of re-training, there was strong support for a flexible approach, with a mixture of short (day release) modules on specific tools and processes, rather than longer periods of off-the-job training.

> *"Cross training between the compound structures is a real skills gap"*
>
> Swansea

However, the overwhelming consensus was that these measures were merely short-term palliatives and that developing a strong talent 'pipeline' within the UK was a strategic priority.

All interviewees from companies thought that apprenticeships were an important part of the solution to skills shortages. They all currently operate apprenticeship programmes at Levels 3–5 and some were involved with degree apprenticeships (Level 6).

One barrier to the future expansion of apprenticeships was the availability of training providers and partners with sufficient specific technical focus and Electronics content within curricula. Another barrier was the lack of awareness about opportunities within the CS Cluster among school pupils.

In terms of degree apprenticeships (both Level 6 and Level 7), it was felt that more Higher Education institutions should be offering further programmes, as employers were attracted to the flexibility of these schemes. More widely, they wanted more students to have the opportunities for more industrial experience as part of their degrees. In the survey, around two thirds of respondents stated that they already offer work placements to students.

Looking ahead, demand for engineering staff educated to Level 8 (PhD) was expected to be high. In the survey, 9 out of 16 respondents identified doctorial research programmes as a future need in the next five years. In addition, 7 out of 16 respondents identified the need for specific modules in postgraduate degree courses, relating to compound semiconductors, to help them grow.

Interviewees welcomed the proposed Centre for Doctoral Training (CDT), particularly the envisaged prospect of 16–25 potential recruits per year in three years' time as the output from the CDT. They also supported the CDT intended approach combining research with industry and innovation. However, there was concern about the size of the potential student input into the CDT and some doubt that even with the CDT, demand may still exceed supply at Level 8.

Opportunities & Threats

During the interviews, we noted a number of potential opportunities and threats; these are summarised below:

Given the heterogeneous nature of compound semiconductor (compared to silicon, which can be considered as homogeneous) there is huge potential in the future. However, some saw the breadth of applications to be a possible negative. On the one hand, the potential growth for compound semiconductors was seen as an obvious positive. However, the wide range of technologies and the huge array of applications means that it is difficult to have a clear focus. Therefore, there were concerns that efforts to develop coherent strategies may by problematic.

Investment in CS Connect as the effective representative body for the Cluster by local and national government, academia, research and commercial companies would allow a single voice to be heard across technologies, processes, training and end applications. However, defining that single voice from the multitude of stakeholders would be a complex task and would need considerable coordination and 'buy in', which has sometimes been difficult to achieve in the past.

Potential external partners in the UK were concerned about how elements of the Cluster would compete with existing provision, especially in wafer epitaxy and device fabrication.

"There's a risk that if we only work with one or two companies we become too focused"

ICS

There are also concerns that the Cluster is not fully taking advantage of collaboration around end market applications.

> *"If Wales is serious about space and drones then it's here at Aberystwyth, with people and facilities, it's here with the radio, sensors, IT, big data, building cameras for space missions and modelling space craft."*
>
> Aberystwyth

> *"The worst possible outcome is to have two facilities in competition"*
>
> Sheffield

Appendices

1. Forecast of Future Growth in Jobs
2. Interview Transcripts (transcripts not included in this publically available version)
3. Survey Data

References

CBI, *In Perfect Harmony (Improving Skills Delivery in the UK)*, January 2018
http://www.cbi.org.uk/index.cfm/_api/render/file/?method=inline&fileID=C55CA42C-E408-4BA4-BCED5937675ED0F0 [Accessed: 28th February].

Engineering UK, *The State of Engineering 2017* report.

The Institution of Engineering & Technology, *Skills & Demand in Industry Survey 2016*.

UCAS, *End of Cycle Data Report for 2017*, published in December 2017.

The UK's Industrial Strategy https://www.gov.uk/government/topical-events/the-uks-industrial-strategy [Accessed: 1st March 2018].

About the UKESF

The purpose of the UKESF is to tackle the skills shortage in a coherent way. Our aim is to:

"**Encourage more young people to study Electronics and to pursue engineering careers in the sector.**"

To achieve the aim, we have four strategic priorities:

- Ensure more schoolchildren are **aware** of Electronics. Show these children, their parents and teachers that there are exciting and worthwhile careers available as designers and engineers in the Electronics sector.
- With our partners, provide opportunities for them to develop their **interest** in Electronics and engineering, through to university study and/or apprenticeship.
- At university, ensure that undergraduates are encouraged to pursue careers in the Electronics sector and they are supported in their professional **development** so when they graduate they are equipped with work-ready skills and experience.
- After graduation from university, we will help create a community of Electronics engineers to secure the future pipeline. We will **build relationships** and act as the representative voice for the sector on skills.

We are an independent charitable foundation at the nexus of an extensive network of partners and collaborators. On behalf of the sector, we will build relationships, provide thought leadership and act as the representative voice on skills related matters.

Registered charity number: SC043940
www.ukesf.org

With Thanks To….

Neil Dickins and IC_Resources

Nick Flaherty

Respondents and Interviewees

Appendices

Appendix 1: Forecast of Future Growth in Jobs

We have attempted to quantify the optimism reported by interviewees about the potential for future jobs by predicting the future skills demand within the core partners of the CS Cluster.

The methodology for making the forecast was to take the 3-year business projections from interviewees (see transcripts at Appendix 2) and combine these with longer terms forecasts. Beyond the 3-year business plan horizon, we acknowledge that there is a degree of speculation. For instance, the figures for years 4–6 would depend upon the successes and deals achieved in years 1–3.

From this analysis, we are forecasting that almost a thousand (939) additional high-value jobs could be created within the core partners of CS Cluster by 2024.

Organisation	Role	2018	2019	2020	2021	2022	2023	2024
		Baseline	Yr1	Yr2	Y3	Yr4	Yr5	Yr6
IQE	Process engineers, Equipment engineers and Operations staff	600	50	50	50	50	50	50
Newport Wafer Fab	Process Engineers	200	20	20	20	20	20	20
Newport Wafer Fab	Cleanroom Technician	200	30	30	30	30	30	30
SPTS	Equipment engineers	55	30	30	10	10	10	10
	Technicians	55	30	30	10	10	10	10
Catapult	Power		6	20				
	Opto		6	20				
	RF		6	20				
	Support		5	6				
Swansea	Cleanroom	200	10	10	10	10	10	
Total		1310	193	236	130	130	130	120
Cumulative			193	429	559	689	819	939

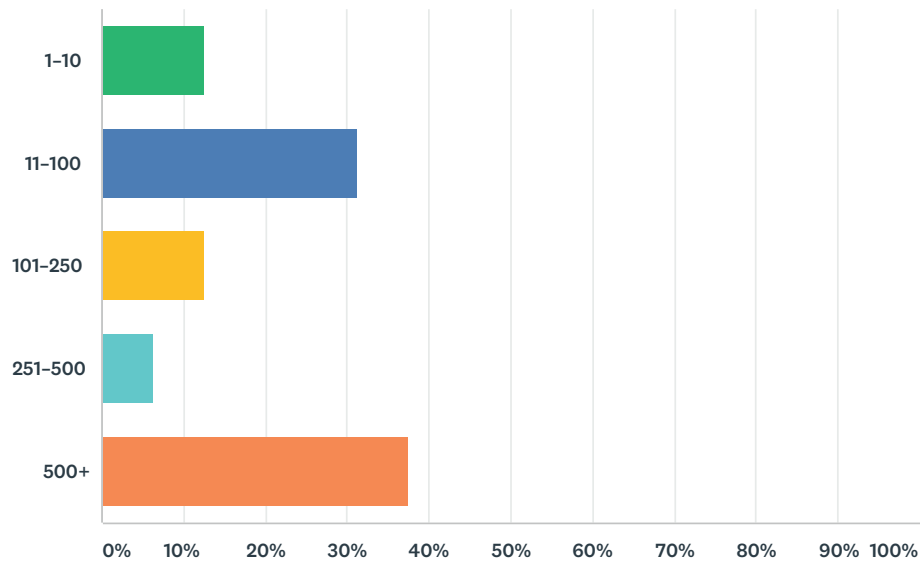Cumulative CS Jobs Growth S Wales - Forecast
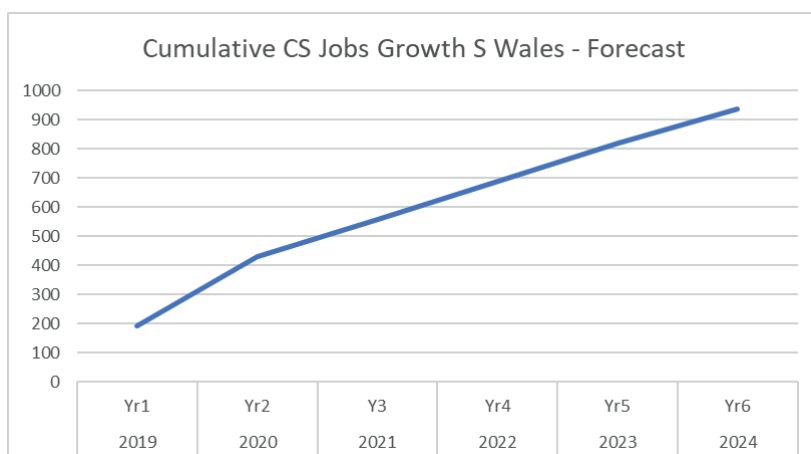
Appendix 2: Interview Transcripts

Transcripts not included in this publically available version.

Appendix 3: Survey Data

Q1 How many staff does your company/organisation employ at your location (please include temporary as well as permanent staff)?
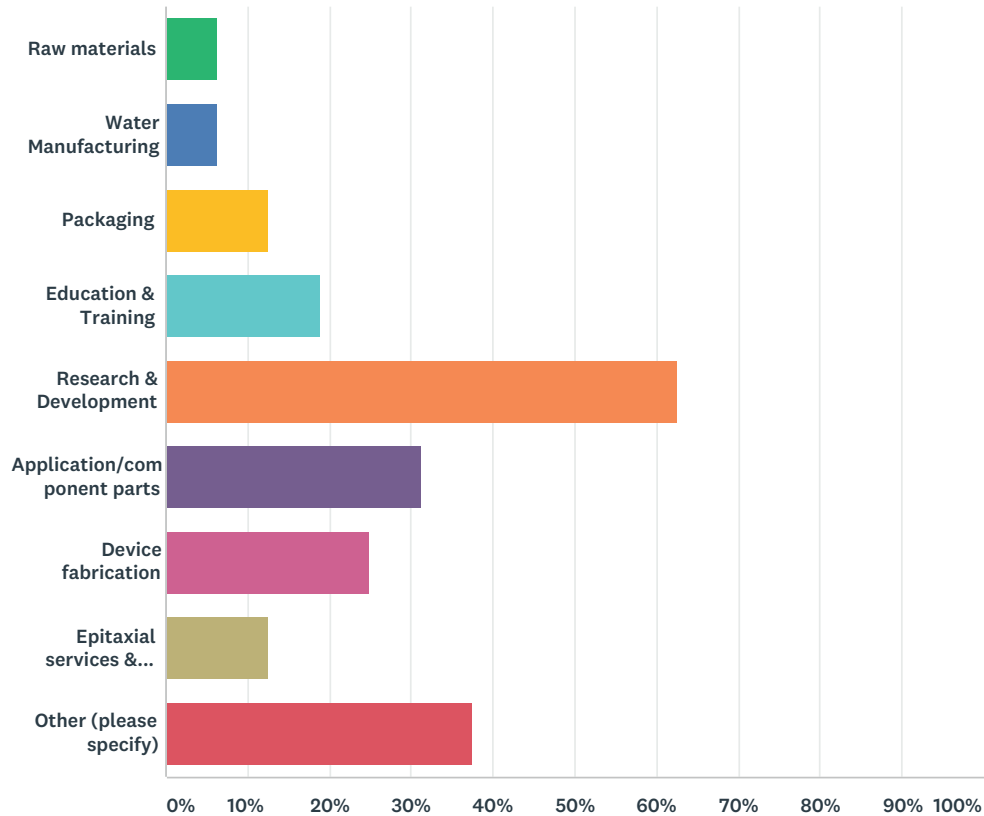
Answered: 16   Skipped: 0

ANSWER CHOICES	RESPONSES	
1–10	12.50%	2
11–100	31.25%	5
101–250	12.50%	2
251–500	6.25%	1
500+	37.50%	6
TOTAL		16

Q2 Please indicate which represents your company/organisation's involvement or interest with compound semiconductors (select all that apply):

Answered: 16   Skipped: 0

ANSWER CHOICES	RESPONSES	
Raw materials	6.25%	1
Water Manufacturing	6.25%	1
Packaging	12.50%	2
Education & Training	18.75%	3
Research & Development	62.50%	10
Application/component parts	31.25%	5
Device fabrication	25.00%	4
Epitaxial services & equipment manufacture	12.50%	2
Other (please specify)	37.50%	6
Total Respondents: 16		

#	OTHER (PLEASE SPECIFY)	DATE
1	Complementary Technology	4/8/2018 7:10 AM
2	Wafer Manufacturing	3/22/2018 5:53 PM
3	Incorporate power electronic switches into complete electrical drive systems.	2/17/2018 12:06 PM
4	Obsolescence	2/16/2018 1:46 PM
5	Ip	2/16/2018 11:32 AM
6	Testing and Compliance of Devices and End Products	2/16/2018 10:50 AM

#	OTHER (PLEASE SPECIFY)	DATE
1		
2		

Q3 Does your organisation have plans to recruit engineering and technology staff in the next 12 months?

Answered: 16   Skipped: 0
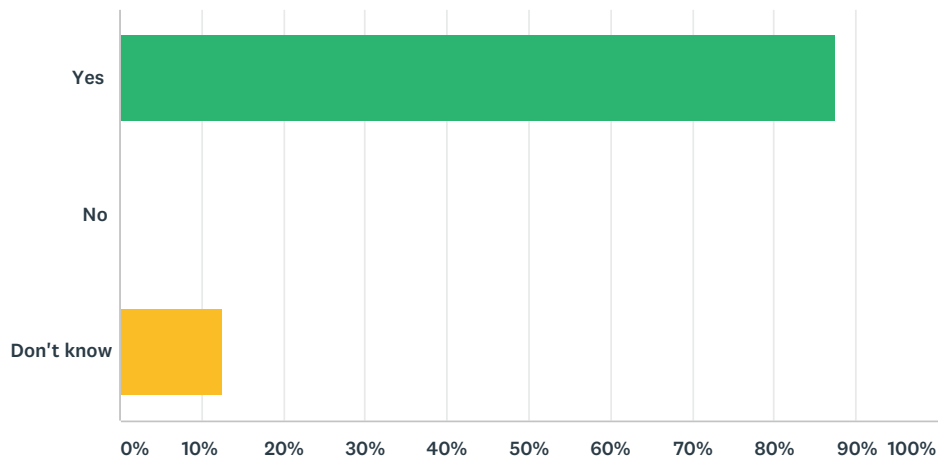
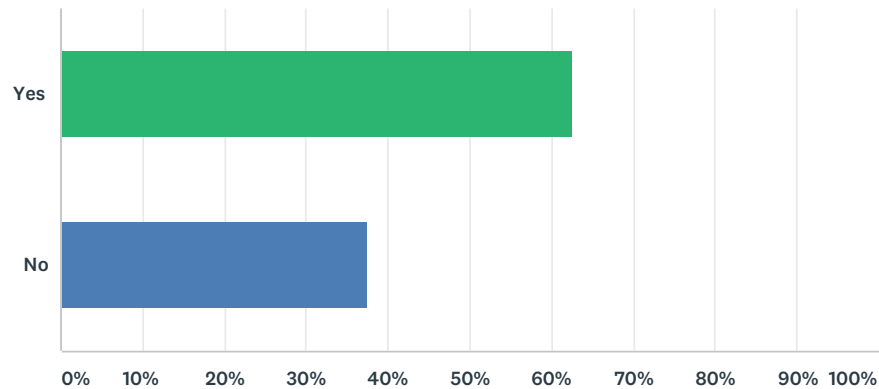| ANSWER CHOICES	RESPONSES	
Yes	87.50%	14
No	0.00%	0
Don't know	12.50%	2
TOTAL		16

#	IF YOU ANSWERED 'YES' OR 'NO', PLEASE EXPLAIN WHY AND PROVIDE APPROX. NUMBERS IF 'YES'.	DATE
1	10 staff over the next 5 years	3/26/2018 12:03 PM
2	TBC - minimum 10 however expectations are significantly higher	3/22/2018 5:53 PM
3	5+ due to ongoing expansion	3/22/2018 11:36 AM
4	Unsure of numbers at the moment	3/21/2018 11:31 AM
5	More student interns (approx 8)	3/6/2018 5:00 PM
6	A few	2/22/2018 4:30 PM
7	4-5 people, as part of natural turn-over	2/21/2018 5:18 PM
8	Currently lookign to grow by 50 heads	2/19/2018 9:33 AM
9	Electrification of propulsion for aircraft.	2/17/2018 12:06 PM
10	5	2/16/2018 11:32 AM

Q4 Has your company/organisation experienced a skills shortage in the last 12 months? That is, an Engineering or Technology vacancy that has remained unfilled for at least 3 months due to the lack of a candidate with the required skill set.

Answered: 16   Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes	62.50%	10
No	37.50%	6
TOTAL		16

#	IF 'YES', WHAT SKILLS SETS WERE LACKING IN JOB APPLICANTS?	DATE
1	This is too general a question. We have had skills shortages in different engineering-related departments fom Sales and Marketing, through IC and Software design, Training, Customer Services and Research. Each requires a different mix of technology and inter-personal skills. The term 'lack of experience' is often used, but is a non-helpful catch-all for educational forward planning purposes.	4/8/2018 7:10 AM
2	Technical research skills	3/26/2018 12:03 PM
3	Process Engineering Shift Engineering Technical Engineering etc	3/22/2018 5:53 PM
4	Mix of commercial programme management with technical understanding.	3/22/2018 11:36 AM
5	Appropriate experience	3/21/2018 11:31 AM
6	Industry experience, specialist technical skills in high level programming languages	3/6/2018 5:00 PM
7	MOCVD crystal growth	2/22/2018 4:30 PM
8	Optics and optical systems design	2/21/2018 5:18 PM
9	Electronics engineers (analogue, digital, power supplies not FPGA/ASIC design).	2/19/2018 9:33 AM

# Q5 To what extent do you currently have problems recruiting at:

Answered: 16   Skipped: 0
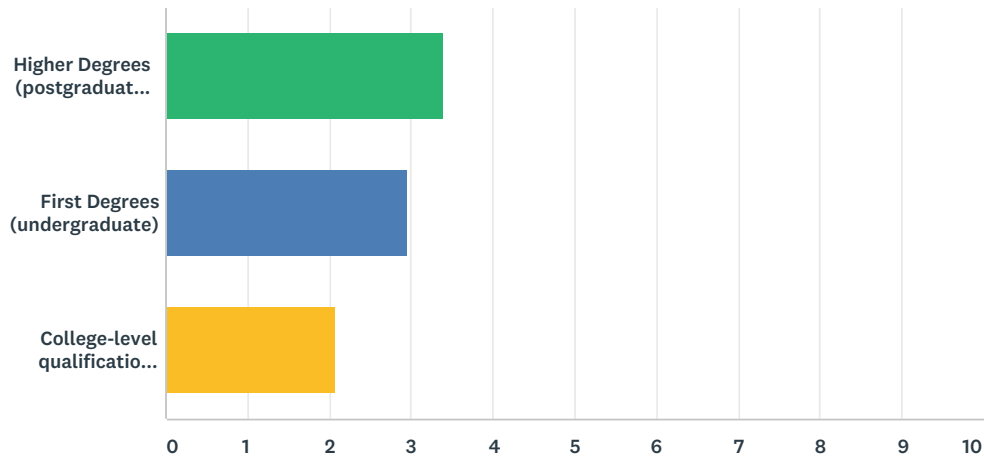
	NEVER	SOMETIMES	OFTEN	VERY OFTEN	ALWAYS	TOTAL	WEIGHTED AVERAGE
Higher Degrees (postgraduate masters, Level 7 and PhDs)	6.25% 1	25.00% 4	12.50% 2	37.50% 6	18.75% 3	16	3.38
First Degrees (undergraduate)	0.00% 0	50.00% 8	18.75% 3	18.75% 3	12.50% 2	16	2.94
College-level qualifications (Levels 3–5)	20.00% 3	60.00% 9	13.33% 2	6.67% 1	0.00% 0	15	2.07

Q6 What problems do you face when recruiting technical staff (select all that apply)?

Answered: 16   Skipped: 0
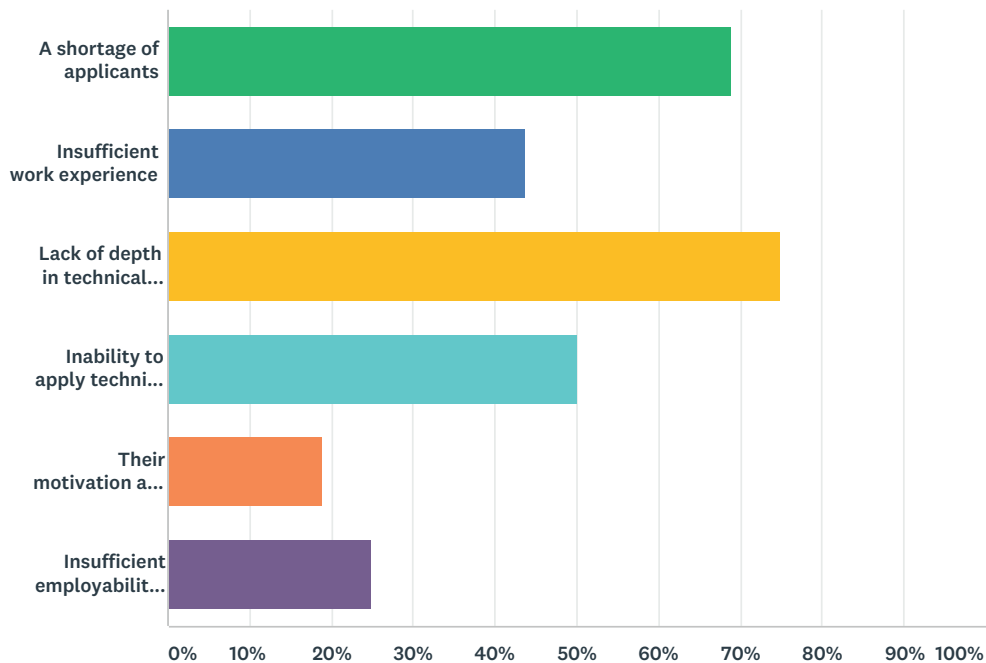
ANSWER CHOICES	RESPONSES	
A shortage of applicants	68.75%	11
Insufficient work experience	43.75%	7
Lack of depth in technical knowledge	75.00%	12
Inability to apply technical knowledge practically	50.00%	8
Their motivation and enthusiasm	18.75%	3
Insufficient employability/non-technical skills	25.00%	4
Total Respondents: 16		

#	IF YOU ANSWERED 'LACK OF DEPTH IN TECHNICAL KNOWLEDGE' OR 'INSUFFICIENT EMPLOYABILITY/NON-TECHNICAL SKILLS', PLEASE SPECIFY/EXPLAIN WHICH KEY SKILLS WERE LACKING.	DATE
1	A highly skilled technical person, may have insufficient skills in the particular area where the job opening is. Form outside the profession it is not obvious that there are so many micro-disciplines within Engineering, each holding its own specialisms, and very few have wide-ranging skills at the expert level. Even if they have a basic profile, in-house training is *always* required to match a person to a new role.	4/8/2018 7:10 AM
2	Existing knowledge in industry the application of the degrees, in relation to semiconductors, compound on silicon semiconductors, photonics. Process knowledge is limited and therefore top up training is required for this industry sector. To enable technical staff to reach the required standard.	3/22/2018 5:53 PM
3	Mix of semiconductor materials and device level knowledge	3/22/2018 11:36 AM

4	Lack of experienced candidates from uk - we typically recruit in India	3/21/2018 1:37 PM
5	Hands on ready-to-go exact expertise	2/22/2018 4:30 PM
6	No specific knowledge in the area of optics for semiconductor light emitters, or in knowledge of semiconductor electronic devices (LED, LD, VCSEL) to recruit to a position involving device R&D Candidates sometime lacking commercial awareness and ability to find innovative solutions to physics based problems	2/21/2018 5:18 PM
7	A lot of candidates struggle to display basic engineering knowledge and most are software based which is not what we want.	2/19/2018 9:33 AM
8	Understanding of semiconductor use	2/16/2018 1:46 PM
9	Analog Design Sram design	2/16/2018 11:32 AM

Q7 On a scale of 1–5, how 'workforce ready' would you say each category of new starter is, and how important is this to your organisation?

Answered: 16   Skipped: 0
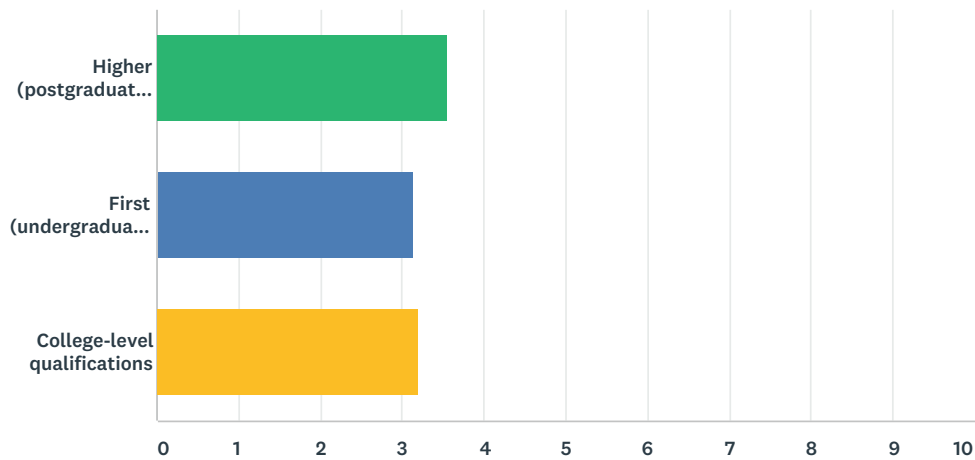
	1) NOT EQUIPPED AT ALL	2) MOSTLY UNEQUIPPED	3) NEITHER UNEQUIPPED NOR READY	4) SOMEWHAT READY	5) COMPLETELY READY	TOTAL	WEIGHTED AVERAGE
Higher (postgraduate) Degrees	0.00% 0	12.50% 2	18.75% 3	68.75% 11	0.00% 0	16	3.56
First (undergraduate) Degrees	0.00% 0	25.00% 4	37.50% 6	37.50% 6	0.00% 0	16	3.13
College-level qualifications	6.67% 1	20.00% 3	20.00% 3	53.33% 8	0.00% 0	15	3.20

#	COMMENTS FOR "HIGHER (POSTGRADUATE) DEGREES"	DATE
1	Its a case of matching expectation and reality.	4/8/2018 7:10 AM
2	Very High	3/22/2018 5:53 PM
3	high	3/22/2018 11:36 AM
4	High	3/21/2018 11:31 AM
5	High	2/21/2018 5:18 PM
6	Expected	2/19/2018 9:33 AM
7	We can always use a strong technical expert.	2/17/2018 12:06 PM
8	Important	2/16/2018 10:39 AM

#	COMMENTS FOR "FIRST (UNDERGRADUATE) DEGREES"	DATE
1	Its a case of matching expectation and reality.	4/8/2018 7:10 AM
2	Very High	3/22/2018 5:53 PM
3	high	3/22/2018 11:36 AM
4	High	3/21/2018 11:31 AM
5	Not important	2/21/2018 5:18 PM

#		DATE
6	Really important	2/19/2018 9:33 AM
7	We can always use a strong technical expert.	2/17/2018 12:06 PM
8	Important	2/16/2018 10:39 AM
#	**COMMENTS FOR "COLLEGE-LEVEL QUALIFICATIONS"**	**DATE**
1	Its a case of matching expectation and reality.	4/8/2018 7:10 AM
2	Very High	3/22/2018 5:53 PM
3	Medium	3/21/2018 11:31 AM
4	We don't recruit at this level	2/21/2018 5:18 PM
5	Important	2/19/2018 9:33 AM
6	We can always use a strong technical expert.	2/17/2018 12:06 PM
7	Important	2/16/2018 10:39 AM

Q8 In what way(s), if any, do new starters not meet your reasonable expectations in any of the following skills areas (select all that apply)?

Answered: 16   Skipped: 0
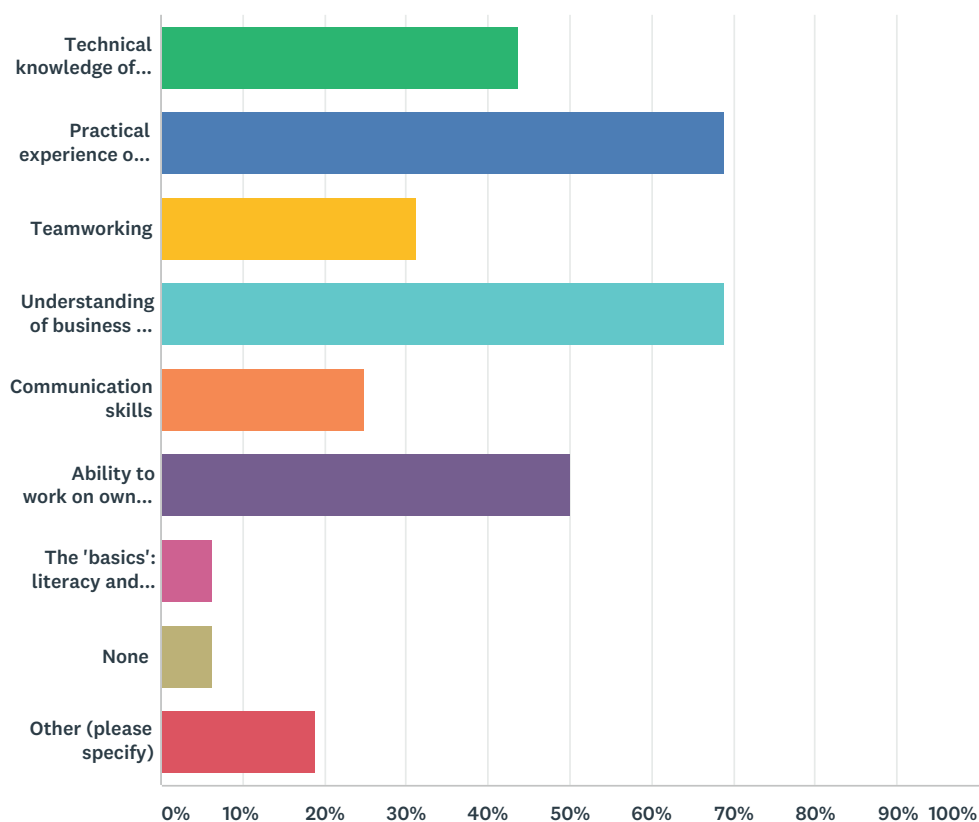
ANSWER CHOICES	RESPONSES	
Technical knowledge of compound semiconductors	43.75%	7
Practical experience of compound semiconductors	68.75%	11
Teamworking	31.25%	5
Understanding of business and commercial acumen	68.75%	11
Communication skills	25.00%	4
Ability to work on own initiative	50.00%	8
The 'basics': literacy and numeracy	6.25%	1
None	6.25%	1
Other (please specify)	18.75%	3
Total Respondents: 16		

#	OTHER (PLEASE SPECIFY)	DATE
1	We have gaps in all areas at all levels and the issues need to be address as a whole to create - a development flow. The Communication of the opportunites in this field also need to be highlighted.	3/22/2018 5:53 PM
2	Semiconudtcor experience in a commercial context	3/22/2018 11:36 AM
3	My business in semi conductors not compound - although have an interest and I'm based in South Wales (Directotr of international semi conductor company)	3/21/2018 1:37 PM

Q9 For new starters, in what ways does your company/organisation support their professional development and training?
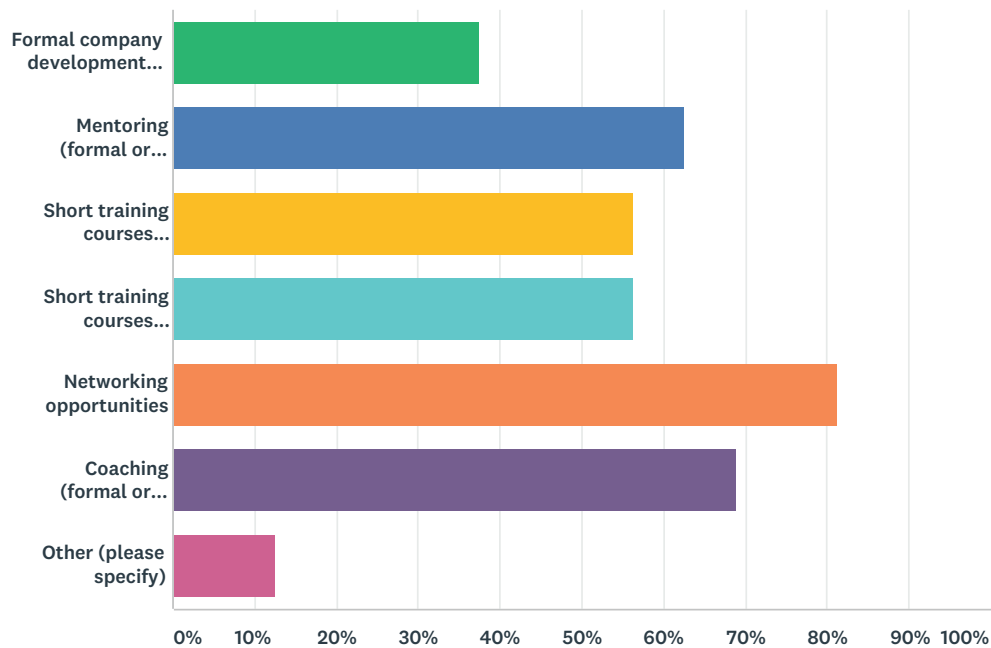
Answered: 16   Skipped: 0
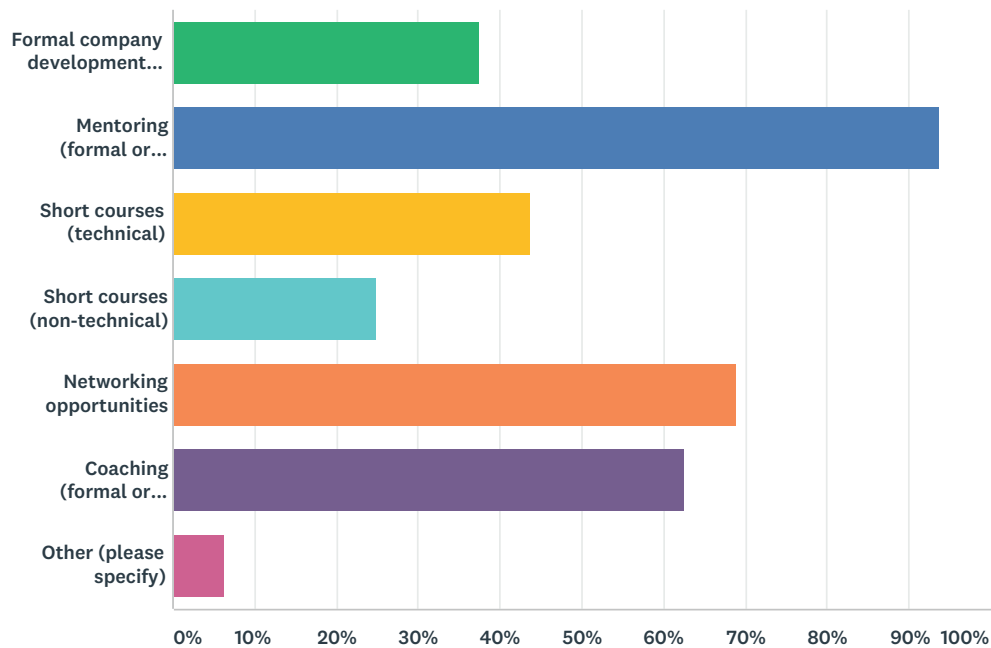
ANSWER CHOICES	RESPONSES	
Formal company development programme	37.50%	6
Mentoring (formal or informal)	93.75%	15
Short courses (technical)	43.75%	7
Short courses (non-technical)	25.00%	4
Networking opportunities	68.75%	11
Coaching (formal or informal)	62.50%	10
Other (please specify)	6.25%	1
Total Respondents: 16		

#	OTHER (PLEASE SPECIFY)	DATE
1	Bespoke solution design to cover skills gaps, full development strategy for all individuals joining the company. Structured to the role, responsiblities and existing knowledge\experience.	3/22/2018 5:53 PM

Q10 For existing staff, in what ways does your company/organisation support their professional development?

Answered: 16   Skipped: 0

ANSWER CHOICES	RESPONSES	
Formal company development programme	37.50%	6
Mentoring (formal or informal)	62.50%	10
Short training courses (technical)	56.25%	9
Short training courses (non-technical)	56.25%	9
Networking opportunities	81.25%	13
Coaching (formal or informal)	68.75%	11
Other (please specify)	12.50%	2
Total Respondents: 16		

#	OTHER (PLEASE SPECIFY)	DATE
1	As above	3/22/2018 5:53 PM
2	Software specific training	2/21/2018 5:18 PM

Q11 Do you offer student work placements?

Answered: 16   Skipped: 0
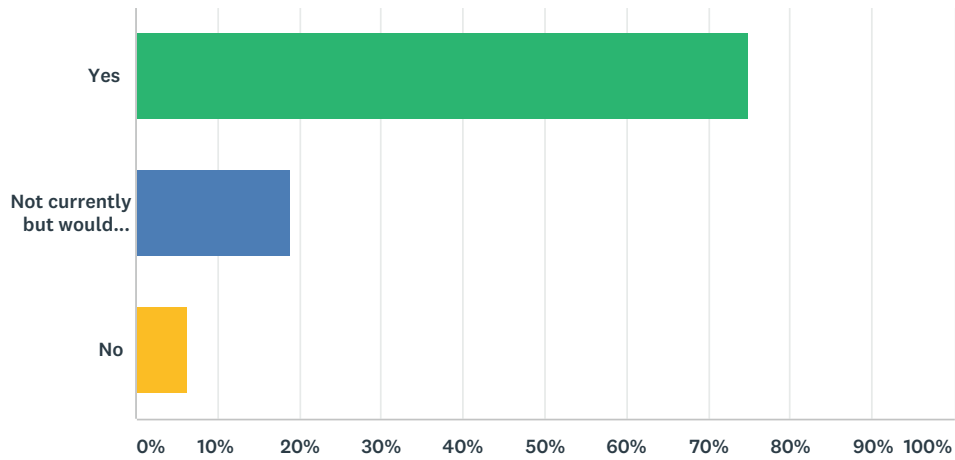
ANSWER CHOICES	RESPONSES	
Yes	75.00%	12
Not currently but would consider	18.75%	3
No	6.25%	1
TOTAL		16

Q12 Looking ahead (over the next 5 years), what future needs in compound semiconductors might your organisation require to support its growth?

Answered: 16   Skipped: 0
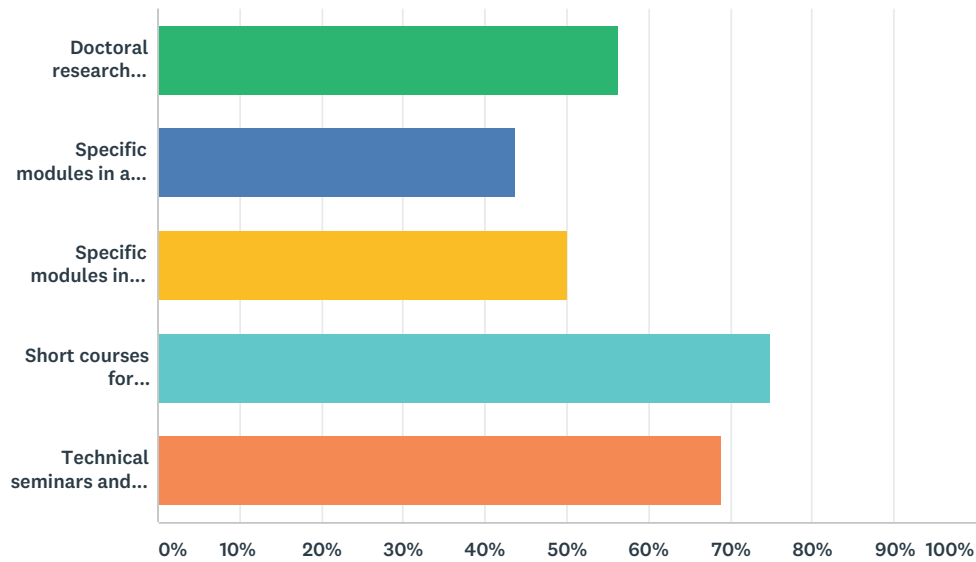
ANSWER CHOICES	RESPONSES	
Doctoral research programmes	56.25%	9
Specific modules in a postgraduate degree course	43.75%	7
Specific modules in undergraduate degree course	50.00%	8
Short courses for professional development (CPD)	75.00%	12
Technical seminars and conferences	68.75%	11
Total Respondents: 16		

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