WHAT DO IT TECHNICIANS DO?

MICHAELA BROCKMANN
ARTI SARASWAT
SOUTHAMPTON EDUCATION SCHOOL, UNIVERSITY OF SOUTHAMPTON

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PARTNERSHIPS WITH ORGANISATIONS WHO
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ACKNOWLEDGEMENTS

Dr Michaela Brockmann

Dr Arti Saraswat

Southampton Education School

University of Southampton

M.Brockmann@soton.ac.uk

DISCLAIMER

EXECUTIVE SUMMARY

1. In the context of another wave of reform of technical education in England, this study set out to enhance understanding of the roles carried out by IT technicians, and the qualifications and training routes that prepare them for these roles. This was an in-depth exploratory study that was carried out in two stages. It consisted of documentary research and semi-structured interviews with sector-level bodies (Stage 1), and semi-structured interviews with employers, FE colleges, private providers, and apprentices (Stage 2).

2. Most of our study participants, notably employers and training providers, associated the term IT 'technician' with somebody carrying out relatively low-level support tasks, such as helpdesk or first-line support. This is in line with popular understanding of the role of technicians. However, following the definition of the BCS Technician Standard as someone, 'who applies their technical knowledge and skills in an IT work environment with confident competence' (BCS, 2016), we found that technicians carry out a large variety of roles, potentially across all levels of the work organisation. While the focus of a technician role is applying technical knowledge, their roles may include elements of managerial and/or strategic responsibilities.

3. Technician roles at Small and Medium-Sized companies (SMEs) are generally broader than at large employers. At SMEs, technicians typically perform a range of activities, with high levels of autonomy and responsibility. An important requirement voiced by our SME participants was that technicians needed to be 'flexible' and able to 'stand in for each other'. While roles at large companies are more specialised and clearly delineated, these employers also appear to value a broad skills base, which may be achieved by rotating trainees/apprentices to different business areas. However, while technician roles within SMEs may involve a wide variety of tasks, these companies tend to be highly specialised, focusing on particular products. As a consequence, technicians in SMEs are required to have broad skill sets alongside certain specialisms.

4. Job titles in IT are fluid, and across different organisations the same title may refer to different sets of tasks. Particularly at SMEs, roles that are labelled IT support may extend well beyond the support function, which in turn may be subsumed by a broader role. New entrants, regardless of their level of qualification, tend to start in support roles as a way of inducting them into the company and/or in order to identify their strengths, with a view towards progression to a more specialist area.

5. IT technicians tend to specialise as they progress. New entrants typically start in a generic support role (e.g. requiring an understanding of infrastructure and networking) and develop certain specialisms (e.g. in a particular product), moving up the organisational hierarchy (e.g. from first- to third-line support). Specialisation develops through a combination of experience and taking additional (vendor[1]) qualifications.

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1 Qualifications which are provided by technology companies and are product-specific (e.g. Microsoft or Cisco) are commonly referred to as vendor qualifications.

6. A large variety of qualifications in IT and computing at Levels 3, 4 and 5 prepare individuals for technician roles. These include full-time courses at colleges or private providers, such as the BTEC Level 3 in Computing, or Higher National qualifications at Levels 4 and 5, as well as apprenticeships at Levels 3 to 5. In addition, there is a host of certifications and qualifications provided by vendors (i.e. qualifications that are product-specific). Vendor qualifications are either stand-alone (commonly obtained as part of Continuing Professional Development (CPD)), or, increasingly, embedded in standard (i.e. state-supported) provision of vocational education, both full- and part-time.

7. Full-time courses tend to be more generic, while apprenticeships prepare for specific job roles. Full-time provision up to and including Level 3 tends to cover a broad range of knowledge and skills in different IT areas, with specialisation at the higher levels (although there are opportunities to specialise at Level 3, and one of the private providers included here offered only specialist routes at this level). Certain specialist areas, such as cyber security, may require higher level qualifications (Level 5 and above).

8. One of the strongest messages which emerged from this study is that employers do not have confidence in existing standard vocational qualifications obtained through full-time study (at any educational level). The reasons include that the knowledge and skills thus acquired are deemed to be out-of-date and not in line with company-specific needs ('the wrong kind of knowledge'). In addition, graduates of such qualifications are perceived to lack both business understanding and social competencies, such as communication skills.

9. Most employers in our sample, notably the SMEs, valued demonstrable competence (including technical and social) and 'attitude', such as being passionate about computing, which both constituted important selection criteria in recruitment. Employers sought to take on people with basic knowledge and skills whom they could then develop according to their own specific needs. Equally, all employers stressed the importance of business skills and social competencies, highlighting the client-facing nature of most IT technician roles.

10. Vendor qualifications enjoy high labour market currency, and all but one employer in our study valued them well above standard qualifications. Crucially, and in contrast to standard provision, vendor qualifications always reflect the latest technological developments. In addition, they serve as a kind of 'licence to practice', certifying their holder's competence in a particular product. Recognising this, training providers increasingly include them in standard IT courses.

11. All employers attached high value to apprenticeship as a model of learning – and all but one company employed apprentices. It was argued by employers that IT was predominantly a practice, and certain skills could not be developed in a classroom environment (notably business skills). A major benefit of apprenticeship was that employers could 'mould' apprentices according to their specific workplace needs, and that the content of apprenticeships could be tailored accordingly. The off-the-job element of apprenticeships was valued, particularly as employers had an input in the particular modules taken by their apprentices. Large employers may value the opportunity to rotate apprentices to different areas of the business, enabling the employer to identify strengths while ensuring that the young people gain a rounded knowledge base.

12. For their part, most of the learners in our sample expressed high levels of satisfaction with their apprenticeships. This related particularly to the workplace element, reflecting the apprentices' preference for 'hands-on' and practical learning. Important aspects here included being able to work with high levels of responsibility and autonomy ('being a full member of the team') and exposure to a broad range of activities. Apprentices appeared to progress quickly during or after their apprenticeships from general support to more specialised roles. They valued the college element of apprenticeship where it was perceived to be closely integrated with workplace practice.

13. Generally, we found little concern with skills gaps, although several participants voiced concern about the gender imbalance in the IT sector. Networking and programming are the two IT areas with the greatest current demand, while the most important growth areas include cyber security, cloud computing, and big data. Notably, the demand is for higher level qualifications (Levels 4 and 5). Two SMEs had experienced difficulty filling certain openings (both apprenticeships and roles at higher level), which was attributed to the specialist nature of the company and/or their being located in perhaps a less desirable geographical area. There was a common suggestion amongst the employers in our sample (both large companies and SMEs) that, rather than recruiting (higher-level) qualified professionals, they preferred bringing in new staff and developing them in line with their unique requirements ('raw talent'). This then also serves as a way of addressing future skills gaps.

14. Keeping knowledge and skills up to date is essential in a sector characterised by rapid technological advance, although some participants highlighted that the core principles and knowledge of computing stand the test of time. Employers stressed that keeping up to date was integral to their workplace culture, and being motivated to stay abreast of technological developments was part of the 'attitude' they were seeking in their employees. Ways of keeping up to date included reading relevant publications, taking online courses, and participating in team discussions. Maintaining up-to-date skills was also important for college tutors. In addition to relevant industry experience, tutors can benefit from vendor qualifications as a means to CPD and to adequately prepare themselves to teach these qualifications.

15. Standard college provision tends to lag behind technology development, largely because of the difficulty and complexity of amending programmes leading to awards validated by external awarding bodies, something that was acknowledged by the representatives of the training providers in this study. It was for this reason that both colleges and private providers had embedded vendor qualifications into their standard courses.

16. Despite an apparent shift in recruitment strategies, including companies increasingly taking on apprentices, there is an ongoing need for university graduates in the IT sector. We were told that graduate skills, such as critical thinking, are valued for higher-level, strategic roles. Notably, despite most study participants' suspicion of knowledge acquired through full-time study, there were some suggestions that theoretical knowledge is valuable and that certain principles, such as algorithms, do not become obsolete but remain valid.

17. Our findings underpinned the need for IT education routes up to and including Level 3 to provide a broad foundation of knowledge and skills, while also

providing options to specialise. Several participants in the study warned against early specialisation, highlighting the importance of introducing young people to a range of IT areas so as to enable them to identify and develop interests in particular areas. There were suggestions that the new apprenticeship standards might be too specific and narrow.

18. In designing IT technical education routes, it is crucial to consider that the digital sector is dominated by SMEs, making up 99.8% of businesses (Tech Partnership, 2016). Based on the findings of this study, the individuals completing these routes are therefore likely to be required to perform generalist as well as highly specialist roles. In addition to a broad knowledge and skills base, any provision would need to include options for specialisation. Relevant vendor qualifications should be integrated into each specialism, where possible or relevant, because of their currency in the labour market.

19. In addition, full-time courses need to include substantial workplace elements so as to ensure that learners are able to transfer knowledge to the practice environment and to develop practical skills. This would also improve the relevance of the content to learners as well as enhancing the status of these routes amongst employers.

20. There is a strong case for improving current careers advice and guidance at schools and colleges, to help build realistic expectations on the careers which IT qualifications can lead to, including clear information on progression routes. Most of the apprentices in the sample had little knowledge of apprenticeships and of the different specialisms available before or at the point of starting their apprenticeship.

21. In aligning the technical routes (college-based and apprenticeships) as part of the government's skills plan, emphasis needs to be placed on providing parity of learning/experience to those who progress through college-based technical education.

SECTION 1 INTRODUCTION

The concern with a severe and protracted skills shortage in the Information and Communications Technology (ICT) sector[2] in many industrialised countries, including England, has been well-documented. According to one estimate, an additional 745,000 workers with digital skills would have been needed between 2013 and 2017 (BIS, 2013). Yet employers are finding it hard to fill their vacancies – more than 70% of large companies and nearly half of smaller firms report difficulties in finding suitable applicants (BCS, 2015). In 2014, in an effort to enhance the growth of the digital economy, the Information Economy Council (IEC) released the Digital Skills Strategy (The Tech Partnership, 2014).

At the same time, a growing body of literature shows England's weak vocational education and training (VET) system and the low status of vocational qualifications, particularly in comparison with other countries (e.g. Brockmann et al., 2011). Many comment on the narrow and fragmented nature of qualifications, leading to a bewildering plethora of possible routes for young people. As Fuller and Unwin (2013) show in their review of apprenticeship frameworks, rather than leading to comprehensive occupational profiles, as, for example, in Germany and historically in England, apprenticeships lead to narrow job roles within an occupational field, and at different levels. Importantly for this project, there is no agreed definition of the term 'technician', which is used at Levels 2 to 5. Indeed, 17 of the 42 STEM frameworks the authors reviewed referred to the term at Level 2, well below the technician level in other industrialised countries (ibid).

The failure of the VET system to produce the skills demanded by employers has been recognised by the British government, who commissioned a series of reviews with the aim of enhancing the system of vocational education, including the Wolf Report (2011) and the Richard Review of Apprenticeships (2012). The government has also pledged to deliver three million apprenticeships starts by 2020, focussing on Level 3 and above, as a major vehicle for addressing the skills shortage.

In view of labour market demands, the lack of high-quality technical education has been a source of particular concern, and there have been calls for 'rebuilding' the FE sector as the main training provider (Evans, 2015). The Association of Colleges (2015) has pointed to the lack of a coherent validation and award system for technical and professional education below the honours degree. Qualifications are currently spread across higher education, adult and higher skills, and a market of professional certificates and diplomas.

In November 2015, the government announced plans for 'ground-breaking' reforms to technical and professional education with the aim to 'set England's system on a par with the best in the world' (Department for Education, 2015). The aim is to simplify what is regarded as 'an over-complex system' and to ensure the system delivers 'the skills most needed for the 21st century economy' (ibid). The government plans to create 15 new technical education routes, which will enable young people to move into an apprenticeship, to progress to Higher Education, or to move directly into skilled employment (BIS and DfE, 2016).

2 The sector is variably referred to as ICT (Information and Communications Technology) and IT (Information Technology). Please note that in the remainder of this report we refer to it as the IT sector.

The system of qualifications and training in IT is a case in point. Traditionally, the IT sector in England has relied on recruiting university graduates (for software engineering roles) who then undergo training in the workplace for up to two years to meet employer-specific skills (Brockmann, 2011). However, employers have been voicing increasing concern that graduates lack both technical skills (which may be deemed out-of-date by the time students graduate) and social competences, such as communication and problem-solving skills (Steedman et al., 2003). Vendor qualifications (such as those from Microsoft) play a major role in the continued professional development of IT professionals.

As part of the government's Trailblazer initiative, new IT apprenticeships have been developed. These are available at Levels 2 to 6, and relate to a range of job roles, including IT technician, network engineer, and software developer. Full-time courses include BTECs for ICT Practitioners at Levels 2 and 3, which contain two mandatory units, plus 16 options from a list of over 40, again reflecting different job roles; and Higher National Certificates and Diplomas (e.g. in Computing and Systems Development). Interestingly, and in some contrast, in its briefing paper on IT assessment, UKCES (2012) refers to technicians in 'operations' and 'support' functions at Level 3 and 4, below that of 'professional' and managerial functions above Level 4.

The IT Professional Standards, which link to the Skills Framework for the Information Age (SFIA) (discussed further in Section 3.1), provide the framework for specific qualifications and job roles. The standards are organised into eight disciplines and split into Levels 3 to 6 (UKCES, 2012). They specify the performance criteria, and the knowledge and understanding deemed to be required by IT professionals, in different areas of activity although they do not refer to specific job roles.

In summary, there is currently a diversity of routes into IT, with a vast array of qualifications available at different levels. What is less well-known is how these qualifications are developed, and how and whether they map onto the labour market and reflect employer demand. Similarly, it is not clear how the knowledge and understanding within these qualifications is developed and taught in such a way as to equip learners to keep up with rapidly advancing technology. The research reported here will address this gap.

SECTION 2 METHODOLOGY

The aim of the study was to enhance our understanding of the roles that IT technicians fulfil in the workplace, and the type, status and content of the education and training provision which prepares them for these roles. The findings could inform the development of the new technical education routes at Levels 3, 4 and 5.

• The research questions were:

• What are the roles carried out by technicians in the IT industry?

• What are the current qualifications and training routes to prepare for IT occupations at intermediate levels (3, 4 and 5)?

• What are the knowledge, skills and competences that employers are looking for in IT technicians?

• How is the underpinning knowledge required for these occupations developed in a context of rapidly advancing technology?

• How do IT tutors perceive the content and structure of the courses they teach, and how do they see them fitting with employment demands?

• What are the learners' views on their IT training courses and relevance to the workplace?

Because of the diversity of roles and qualifications in IT, and the lack of available information on IT technicians, it was decided to adopt an exploratory, qualitative approach. The research took place in two stages and involved: documentary research and semi-structured interviews with sector-level bodies, followed by semi-structured interviews with employers, FE colleges and private training providers, as well as learners. All participant organisations were located in London and the South East of England.

First, we drew on documentary evidence, such as reports on the IT workforce, and policy documents concerning education and training. This was followed by semi-structured interviews with four sector-level organisations:

- the professional body, BCS, The Chartered Institute for IT (hereafter referred to as 'BCS');

- the employer-led organisation responsible for developing skills in the sector, the Tech Partnership;

- an awarding body;

- the UK Commission for Employment and Skills (UKCES).

The first stage served to gain an overview of IT occupations at Levels 3, 4 and 5, as well as the qualifications and routes that prepare individuals for them, and how these are developed.

Our intention was that, based on the preliminary findings of the documentary analysis and interviews with sector-level organisations, we would identify the range and type of occupations and roles to be investigated in the subsequent research of employers and training providers. However, this proved extremely challenging because of the diversity and fluidity of roles, as will be discussed further in Section 3.1. Instead, it was decided to purposively select a sample of employers

that represented a range of 'cases', i.e. different-sized employers (SMEs and large companies), as well as IT and non-IT businesses. The particular IT occupations these companies employed were part of the focus of the research.

Interviews with employers usually involved the companies' owners (SMEs) or managers in charge of education and training or with responsibility for apprentices (large employer). Interviews with providers were conducted with a range of staff, including head of computing, course leaders/co-ordinators and tutors.

The learners in our study were recruited from the employers in the sample, and, in one case, from one of the FE colleges. As the fieldwork started in late May, students of full-time college courses were sitting their exams or had already left for the summer. Therefore, all the learners in the study are apprentices.

Interviews were conducted using a topic guide which was informed by the findings of Stage 1 of the research. In the interviews with employers, we sought to yield information on the roles of IT professionals at intermediate levels in their companies; the range of activities these involved and the level of specialisation; and the knowledge and skills they required and how these were developed in the workplace. We were careful not to impose the term 'technician' due to its common association with low-level support roles (discussed in the next section). In the case of FE colleges and private training providers, we asked respondents about their perspectives on the courses they teach, their status and content, and the roles these prepared students for. Interviews with apprentices explored their experiences of apprenticeship, and their anticipation of the future.

Table 1 on the next page provides a summary of the interviews conducted with employers, providers and apprentices in Stage 2 of the research. In total, 15 interviews were conducted between May and September 2016. As can be seen from Table 1, some of these were group interviews. On average, the interviews lasted between one hour and one and a half hours. The interviews were audio-recorded and subsequently transcribed. The analysis was conducted through an analytical framework, guided by the research questions.

Table 1: Summary of employers, providers and apprentices interviewed

Organisation	Number of interviews	Apprentices
Employers (number of employees)		
Micro-company (IT start-up) (2)	1	
SME (IT - networking) (50-100)	1	2 (group interview)
SME (IT - software development) (10-20)	1	
SME (IT - web design) (5-10)	1	
SME (non-IT) (10-20)	1	1
Large employer (IT and computing) (20,000+)	2	3 (group interview)
Training providers		
FE college A	1 (4 participants)	1 (large non-IT company)
FE college B	1 (3 participants)	
Private provider A	1	
Private provider B	1	

SECTION 3 FINDINGS

This section presents the findings based on our interviews at Stages 1 and 2 of the research. The section is structured according to our six research questions, as listed in Section 2 of this report.

3.1 WHAT ARE THE ROLES CARRIED OUT BY TECHNICIANS IN THE IT INDUSTRY?

First of all, it was important to identify and describe the roles of IT technicians, and the tasks and activities these roles entailed, as well as the level of responsibility and autonomy they required. As will be shown below, contrary to the popular understanding of technician as (low-level) IT support, technicians fulfil a wide variety of jobs and roles, across the full range of areas in the IT industry, and at different levels of the organisational hierarchy. Our working definition of 'technician' (guided by the BCS Registered IT Technician Standard) is of someone applying knowledge and skills to solve technical problems.

Some of the most prominent roles (and associated responsibilities) include: infrastructure or support technician (providing first- or second-line support, maintaining and repairing software and hardware systems and dealing with clients either from the helpdesk or on site); software technician (coding, developing solutions and products in line with client specifications); network technician (building, installing, repairing and troubleshooting networks); and web design technician (creating websites and supporting web development).

Job roles sit on a continuum from generalist to specialist, with roles at more advanced levels tending to involve a higher degree of specialisation. Technicians at SMEs tend to assume a wider range of activities compared with those at large employers. Job titles, notably at SMEs, are often vague (particularly that of IT support), allowing flexibility to include tasks and responsibilities well beyond the support role. However, as will be demonstrated below, roles at SMEs equally involve high levels of specialisation (i.e. in a product).

3.1.1 Lack of recognition of technicians

BCS has been keen to promote the status of technicians:

> …[technicians] don't realise how good they are, and if they are they don't get recognised externally for how good they are. And it's really frustrating because there's some wonderful [ones], [they've] done some amazing things. They're not recognised, they're not rewarded, they only get finger pointed when things go wrong and that's just so wrong. (Representative, BCS)

However, as expressed by the BCS representative in our study, enhancing the image of technicians poses major challenges. Technicians have historically held a low status in British society due to a misconception that they occupy low-level support roles:

> …it's got a big hurdle to overcome because technicians are historically the people who fix the printers or come and put a PC on your desk or very menial, lowly tasks and that's a hurdle we're trying to overcome. (Representative, BCS)

The stigma associated with IT technicians is also perceived to prevent young people from entering the profession, as observed, for example, by the interviewee of the start-up company in our sample:

> …*technicians are very much associated with [this] introverted, isolated geek … who has got a pocket protector, glasses and really isn't social and that's not attractive to a young person. (Representative, Start-up)*

This was echoed by the BCS respondent. He felt that the stigma was related to a general lack of information about the activities performed by technicians and the range of industries people can enter, given the ubiquitous nature of IT:

> *I think a lot of people don't consider careers in IT at all, simply because [there is a perception that] they're a bunch of dozy geeks, I don't want to join them thank you very much, they're really boring, but I think a part of that is not realising what a career in IT can offer and how broad it is because you can go anywhere, you can join any industry you like because it does underpin everything you do, the whole of modern life. So if you want to get into aerospace you can get in through IT and get into space through IT, if you want to get into manufacturing go through IT, there's any number of things you can do. (Representative, BCS)*

BCS have worked to promote the status of technicians, notably through the development of a professional standard. The Register for IT Technicians (RITTech) was launched in November 2015, with 330 registrations so far.

> …*so we're trying to do a number of things; one is recognise people who do the work well, but also get the term 'technician' familiarised and established as something that's got appeal and kudos and something you actually want to have.… (Representative, BCS)*

The RITTech is a certification below Chartered Status and was developed based on the Skills Framework for the Information Age (SFIA). SFIA is an international framework that maps competencies for IT professionals across seven levels of responsibility, describing for each level the responsibilities, level of autonomy, and the skills required to perform at a particular level. It is designed to help develop the IT workforce to match the needs of the industry. The seven levels are summarised by a word or phrase as follows:

1 Follow

2 Assist

3 Apply

4 Enable

5 Ensure and advise

6 Initiate and influence

7 Set strategy, inspire and mobilise

The Registered Technician Standard aligns most closely with SFIA Level 3 (Apply), which is the threshold for admission, and SFIA Level 4 (Enable). The description of competence for SFIA Levels 3 and 4 are as follows (in abbreviated form) (BCS, 2014):

SFIA Level 3: Apply

Works under general supervision and uses discretion in identifying and resolving complex problems and assignments. They usually require specific instructions with their work being reviewed at frequent milestones, but can determine when issues should be escalated to a higher level. Interacts with and influences department/project team members. In a predictable and structured environment they may supervise others. They can perform a broad range of work, sometimes complex and non-routine, in a variety of environments. They understand and use appropriate methods, tools and applications and can demonstrate an analytical and systematic approach to problem solving. They can take the initiative in identifying and negotiating appropriate development opportunities and demonstrate effective communication skills, sometimes planning, scheduling and monitoring their own work. They can absorb and apply technical information, work to required standards and understand and use appropriate methods, tools and applications.

SFIA Level 4: Enable

Works under general direction within clear framework of accountability and can exercise substantial personal responsibility and autonomy. They can plan their own work to meet given objectives and processes and can influence their team and specialist peers internally. They can have some responsibility for the work of others and for the allocation of resources. They can make decisions which influence the success of projects and team objectives and perform a broad range of complex technical or professional work activities, in a variety of contexts. They are capable of selecting appropriately from applicable standards, methods, tools and applications, and demonstrate an analytical and systematic approach to problem solving, communicating fluently orally and in writing, and can present complex technical information to both technical and non-technical audiences. They plan, schedule and monitor their work to meet time and quality targets and in accordance with relevant legislation and procedures, rapidly absorbing new technical information and applying it effectively. They have a good appreciation of the wider field of information systems, their use in relevant employment areas and how they relate to the business activities of the employer or client.

The SFIA levels represent increasing levels of autonomy and responsibility. What distinguishes technician roles is the *primary* focus on technical tasks, although this does not preclude elements of managerial or strategic functions. As explained by the BCS representative:

> *[SFIA] Level 3 is very much… you're a competent technical worker and you're able to use your knowledge and skills confidently. So you are autonomous to a degree, you know when to escalate things up but you're really capable at that level…. More senior than [SFIA Level 4] they are unlikely to remain technicians as such, simply because their job role means they are increasingly likely to move away from current technical competence in the actual 'doing' of technical work – more into managerial, enabling and influencing. (Representative, BCS)*

SFIA levels do not align to equivalent educational qualification levels. The BCS representative thought SFIA Level 3 would broadly equate to qualification Levels 3 and 4. He suggested that the Technician standard would include IT professionals with qualifications at Level 3 and above:

… some Level 4 I think will be very comfortable, at Level 5 … Level 6 they're probably … looking at charter status but they could still be a technician. They could still be very technically adaptable to what they do […] it's all about the doing not the knowing, it's a technical competence of what people do. And people can maintain that but they're far more likely to manage people the further they progress. (Representative, BCS)

3.1.2 Diversity/fluidity of roles and job titles

Job roles and titles in IT are extremely diverse and difficult to identify. As explained by representatives of BCS, due to the rapid advance in technology, roles are constantly evolving and there is no central core of skills in IT. Another problem is that employers use job titles very fluidly – different job titles may refer to the same set of activities.

Companies may use SFIA as a toolkit for benchmarking, identifying skills gaps and/ or assessing staff against their roles. SFIA describes IT roles and the skills needed for them across seven categories (such as Strategy and Architecture, and Development and Implementation) and 17 sub-categories. For each category, it lists a number of skill areas (97 across all categories), plus skills at the different SFIA Levels 1-7 discussed earlier (around 300 altogether). Employers can pick any of the skills, at any level, and combine them into a job description. We asked BCS to provide us with a list of SFIA Level 3 job roles, looking at their 13 biggest clients. The work yielded 158 job roles, using 27 different SFIA primary skills.

3.1.3 Technician roles in the workplace

In Stage 2 of the research, we asked employers and providers what their understanding of a technician was. The dominant response reflected the traditional understanding of technician as someone carrying out relatively low-level support tasks:

So the technician role would be [the person] who does the server administration, general running of the office equipment and that sort of stuff, that's what we would define the technician as. (Representative, Software development SME)

Although some respondents offered a slightly broader definition:

… the skills that I think someone with the title of a technician would have is computer hardware skills, being able to troubleshoot, maintain and repair PCs, as well as broader skills on computer network understanding and server understanding. Maybe not a specialism such as a vendor certification, but being able to set up, configure, troubleshoot basic networks as well as basic server environments, as well as the hardware skills. (Representative, Private provider B)

A crucial distinction is between large employers and SMEs

The breadth of roles performed by IT professionals generally was seen to vary with the size of the employer. All participants agreed that the roles of IT professionals at SMEs involved a broader range of activities, compared with those at larger employers, which would typically be narrower and more specialised:

… small employers are looking for someone who can take much more responsibility and perhaps risks in a way because they need someone who can adapt quickly and learn quickly as they go … much more flexible and adaptable people who don't fit into any particular pigeon hole but [can] take on say a bit of software development, a bit of networking, a bit of engineering and release management … Much more in

a hybrid role than big companies who say, right I want a software developer Level 4 here and I want a UX designer here and an architect, so big companies have much more rigid roles…. (Representative, BCS)

… if it's your medium-to-large [company], the job title might be something along the lines of network analyst, network engineer, etc. If they're applying for [an SME], then it might be a more rounded role which might not only specialise in networking, so might be labelled as IT support engineer, IT support analyst. And perhaps the reason it's called that is because they're expected not to just have network skills and work in a silo, but rather do a broader set of things…. (Representative, Private provider B)

The representatives of the SMEs in our sample also underlined the breadth of the roles occupied by staff in their companies. The manager of the software development company explained that in a smaller company, staff had to be able to stand in for each other:

So where my main job is software developer, we've been a tight-knit company that you do have to take on other challenges as well … being in a small company if one other person is not in and an issue arises, you would still need a bit of knowledge to help fix that. So even though I'm a developer, I've still done a lot of the [IT support] side … when [the IT support person] has not been there. (Representative, Software development SME)

He went on to explain that their software developer apprentice also stood in for the other developers as he 'had an understanding of what needs to be done'.

SME representatives confirmed the importance of staff being able to take on a variety of tasks:

…the sort of hybrid is the ideal role for us because of being in a small company … yes, [name] is the designer and yes, [name] is a developer, but because of being in a small business and because they're intelligent guys, they have other strings to their bow in the sense that they've got a good rapport with customers. They can take on other roles, which is a massive help within a small business. (Representative, Web design SME)

The role of the lead developer at the Web design SME, included a multitude of tasks, based on his high level of expertise and years of experience:

… he does get involved in helping everyone in the company, whether it be on the design side, the development side, even with regard to helping our customers, so customer-facing as well. (Representative, Web design SME)

The roles of IT professionals at the large employer seemed indeed more clearly defined and delineated. The company operates across different areas (such as business, technology services, and analytics), and offers a large range of products (related to, for example, systems, software, and storage). This division is reflected in the job roles. In our study we focused primarily on the company's support services, which include helpdesk and field engineers.

It is interesting, however, that both representatives of the large employer insisted that roles, such as field engineers, were broad rather than specialised. They asserted that they required their staff to have a range of skills, as the work was essentially driven by client needs and 'the expectation is that the service provider will have the range of skills to provide support':

… the work that we do tends to be client-focused and so … if a client is looking specifically at mobile-based technologies and apps and so on, that's necessarily where all your experience and focus will come … if you work for one particular banking partner and you go and work for another financial institution you may take some of that knowledge and so on with you but … it may be totally different solutions, one might be legacy, one might be brand new, and one might be based on analytics … we don't specialise in any one thing … it gives a whole variety of different opportunities to our people, so those that maybe have a specialism, for instance in test, it doesn't just mean they do the same tests all the time, they may do functional tests, maybe performance testing … maybe testing different systems, they might be web-based, mobile-based, so … there's always variety there and so to pin it down and pigeonhole it is just too difficult, I think. (Representative, Large employer)

The interviewees from this company also pointed out that engineers had to deal with a growing range of products, including the company's own and an increasingly larger range of multi-vendor equipment.

It appears, therefore, that the roles of IT professionals in large companies are more clearly defined (i.e. in terms of support or development) compared with those in SMEs. However, as is also suggested, the skill sets required for these roles may be increasingly broad, reflecting client demand and growing diversity in technology.

By contrast, our findings suggest that the IT roles in SMEs, while covering multiple functions, may be highly specialised in a particular product or system. For example, the respondent from the software development SME explained that, while the day-to-day work of staff in the company involved a range of tasks, the developers all specialised in one programming language (C#) and focused on particular products:

So currently in our case it's Online Dynamic Support which is a software product aimed at the Dynamic DX market. And it's basically a communication platform, a controlled communication platform where you can do a voice call over the internet, you can do screen sharing, you can do file transfer, you can do instant messaging, sort of like Skype if you know it. So within our day-to-day activities, we sort of support our maintenance of the code and any requests that we get through, developing new features, documentation … testing, test plans, along those lines. (Representative, Software development SME)

Likewise, the non-IT SME is a highly specialised company, providing CDs to a niche market. Indeed, the respondent revealed that they found it difficult to recruit new staff because of the specialist skills they required, including the programming language they used.

IT support roles may be broad with high levels of autonomy
Interestingly, our evidence suggests that roles that are labelled IT support roles (i.e. those that are commonly referred to as 'technician roles') in reality may extend well beyond support tasks. Especially in SMEs, the support function may be subsumed by a broader role. (Note that the interviewee refers to support tasks as 'technician jobs'.)

… probably the technician-level jobs get devolved to [the apprentice] mainly but he has other skills – debugging and coding skills that are on top of that … he has extra coding skills but he has the technician-level tasks that he does: he changes the back-up tapes, he gets the toner changing tasks dumped on him, he's actually upgrading the memory in all the PCs at the moment. So when that sort of a task

comes along, which I see as a technician task, he gets it, but he's much more … he is doing coding work on particularly the intranet and also he is building a subscription system for us. (Representative, non-IT SME)

Because we are such a small company, it tends to be the technician-level task plus some coding. Or development roles. Also testing, testing is something that we get the apprentices to do. (Representative, non-IT SME)

Staff at College A explained that apprentices at Level 3 or 4 would usually go into technical support roles, where their tasks included preparing networks or 'fixing faults'. However, these roles, while labelled 'support', were much more fluid. This then enabled employers to develop the person in particular areas:

…when organisations take on apprenticeships for the first time they just think up a simple title for that apprentice. And normally it's the type of technical support because it kind of encompasses everything. As that individual grows in the company the company starts seeing how they can use that individual to their own potential and hence they might start going into the security side or the web development side, or they're given a mobile app development project to do. So it kind of changes depending on what that individual is capable of. So the job description is very open in terms of what the individual does, but the title sometimes remains the same, you're a technical support person.… (Representative, College A)

In a similar vein, staff at College B highlighted the benefits of an IT support role as a way of inducting apprentices into an organisation. Job titles typically included IT Technician, PC Maintenance Support, Initial or Frontline Network Support, and Helpdesk Support:

… I can't imagine many of our Level 3 students … going into a company where they are immediately released onto a network system because there's too much at stake, isn't there? Also, you know with any organisation regardless of the skills you've got within your industry, you need to be able to understand the organisational structure and how that organisation works, and really kind of [spending time as a] PC technician would be part of learning how that network operates before you'd be let loose on it. (Representative, College B)

The breadth of tasks expected from someone in an IT support role would also vary depending on the size of the company. Whilst interviewees from College B believed that apprentices were unlikely to be given access to company networks, there was a difference in the level of autonomy and responsibility offered to apprentices in smaller organisations, and the opportunities for learning in SMEs were greater:

If there's an apprentice in an organisation where they've got 20 employees overall the chances are that apprentice is going to be having quite a lot of autonomy over the network and the sort of way the PCs are managed because they need someone to try and do everything. Whereas if you go into a large organisation where you're very much kind of a cog in the big machine then you're probably quite limited on what you're doing. (Representative, College B)

3.1.4 Technicians at different levels of the organisational structure

As explained earlier, our study is guided by the BCS definition of Technician and the relevant SFIA descriptors. Based on this definition, our findings suggest that technicians may work at any level of the organisational structure, and the technician role is by no means restricted to low-level IT support tasks. Rather, the distinction is between, on the one hand, technical roles, with a primary focus on solving technical issues, and roles with a management or strategic focus on the other. Importantly, a technician's role may encompass elements of either, particularly at the higher levels.

The definition provided by the representative of Private provider A seemed close to that underpinning the BCS RITTech Standard:

> I think a technician is very much a practical doing type job, and these are the people that make the networks run, set the systems up, do … the coding and the programming and the creation of websites … the further up the train … people tend to be more in the strategic and design rather than the practical doing … the technician role is for people who've got the real practical skills that do a lot of the stuff that makes your IT infrastructure work, or makes your website work or makes your digital marketing activity happen, would be how I would term the technician role. (Representative, Private provider A)

And:

> … the technicians are very much the people that kind of would do a lot of the day to day work … and the managers and more senior people are the ones that I guess are doing the strategy and people management and those sorts of things. So yeah, the technicians are the life blood of the organisation really…. (Representative, Private provider A)

Several respondents referred to the system of first-, second- and third-line support, with IT problems being escalated to the next level up, depending on their complexity, as explained by the representative of Private provider B below. It is apparent that technicians may work at any of these levels, from customer/helpdesk support to more advanced engineering roles:

> … a first-line engineer typically would be you've got an issue with your system, you call the helpdesk and that would hit usually a first-line helpdesk person who will log your problem, try and help you. If they fail to, they'll escalate to second-line. Second-line might be, in my view, someone at Level 3. So perhaps … a Cisco engineer and he finds out that there's some configuration setting that's stopping your PC from accessing the network. So you would fix that. And if he's unable to do that, he'd escalate to a third-line engineer. (Representative, Private provider B)

The Networking SME in our sample operated such a system (which the respondent referred to as Tiers 1, 2 and 3). The example also serves to illustrate the distinction between technical and strategic functions.

The strategic decisions in the company are taken by the senior management board. These decisions are then implemented by the 'team of technical experts', who form Tier 3 of the support system. While these experts have essentially a technical function, each specialising in a particular product, they also play a part in strategic development:

… these experts are essentially technical or sector specialists or functional specialists … So we've got a fantastic guy who's joined us who is an expert in networks and how wide area networks operate, so he is an expert that reports to one of my colleagues here and his role is of … technical specialist. (Representative, Networking SME)

Tier 1 is their first-line support of mostly helpdesk staff, taking on calls and trying to deal with client problems ('talking to clients a lot, trying to achieve first fix … and essentially doing a technical client-facing job'). Where problems prove too complex they are escalated to Tier 2, largely composed of field engineers, whom the respondent described as 'technically very proficient who can handle a range of different technical problems, are strong problem solvers and able to get things fixed'. If they cannot solve the problem, they will pass it to their colleagues at Tier 3, the 'technical experts' who 'look at high-level issues and strategic development':

> *Your Tier 2s are the ones that then go everything's been filtered from the Tier 1, I've now got a handful of issues that I need to concentrate on so it's much more … a much smaller number of transactions at Tier 2. And then by the time you get to Tier 3, Tier 3 are dealing with those transactions the Tiers 2s cannot deal with or where something has taken too long for a Tier 2 person to fix and then it gets escalated to Tier 3s … (Representative, Networking SME)*

Interestingly, while referring to all their IT staff as 'technical', the respondent described only those in Tier 1 as 'technicians', echoing the popular definition as low-level support. However, based on the definition in this study, it is apparent that all the staff in the tier system might be called technicians. Their main focus is to apply knowledge to address technical problems. The complexity of the tasks increases with each level, and, for those at Tier 3, includes an element of strategic planning.

The large employer representative exemplified the variety of roles occupied by technicians, referring to the title of senior engineer in their organisation:

> *… so a [senior] engineer … is a technical executive so not just a business leader … setting the strategic direction, but … they still, you know, to all intents and purposes, they're a technician. They just happen to be in an executive position. (Representative, Large employer)*

3.1.5 Progression from general to specialist roles

A common suggestion was that IT professionals become more specialised the further they progress. For example, it would be common for a new entrant to start in a generic, first-line support role and develop certain specialisms (typically through a combination of experience and qualifications), moving up the organisational hierarchy. The interviewee of the networking SME explained that the tiered structure represented degrees of specialisation:

> *… a Tier 1 engineer will have quite generalist IT technician or IT practitioner qualifications, at Tier 2 you have that generalist approach but you are beginning to develop your specialist knowledge base, and by Tier 3 you are a technical specialist in a particular product stack. (Representative, Networking SME)*

Whereas staff working at Tiers 1 and 2 were expected to have an understanding of both infrastructure and networking ('infrastructure engineers need to be able to network'), staff at Tier 3 were specialising in a particular product:

So for example I mentioned our network engineer. He is highly qualified in Juniper, which is one of the platforms that we work on, and so that level of qualification makes him a technical expert at this level. (Representative, Networking SME)

Asked whether all roles involved some level of autonomy, the interviewee replied:

I think we are not at a scale where we have an option to do otherwise. I think that, you know, we want to have very ambitious people, we will push people to really kind of develop themselves as quickly as possible, so there is a lot of autonomy and responsibility that you get even when you're at Tier 1. So you can be a Tier 1 engineer or Tier 1 client services engineer, desk engineer, and be involved in training and developing an apprentice. (Representative, Networking SME)

The increase in specialisation with seniority was echoed by other participants. The representative of Private provider B explained that, whereas someone with a Level 3 qualification might go into an analyst or support role with a generalist remit, someone at Level 4 might work as a network engineer or consultant, typically specialising in a particular product. The specialism, which is achieved through certification by the particular vendor, then becomes part of the job title, such as, for instance, Microsoft server engineer, or VMware engineer for cloud services. He explained:

… I refer to that because one of the qualifications is the VMware certification, and … VMware has 80% of the market share in server virtualisation space, so they're a market leader in that area. So you might have VMware engineer. Citrix, as an example, as a vendor, is used in a lot of public sector and education establishments and they're a market leader in desktop virtualisation, so delivering desktops to clients and stuff. So you might have a Citrix engineer. (Representative, Private provider B)

These examples highlight the strong labour market currency of vendor qualifications, something that will be discussed in more detail in Section 3.2. Progression and specialisation are commonly based on gaining (vendor) qualifications as well as experience. Referring to the different levels of support roles, the interviewee from the Private provider B explained:

And typically … the levels go up based not only on qualification but on experience. So a first-line engineer might be two or three years' experience, second-line might be, I don't know, up to five years, typically, and third-line might be five years plus. (Representative, Private provider B)

3.2 WHAT ARE THE CURRENT QUALIFICATIONS AND TRAINING ROUTES TO PREPARE FOR IT OCCUPATIONS AT INTERMEDIATE LEVELS (3, 4 AND 5)?

This section presents an overview of IT qualifications at Levels 3, 4 and 5 that prepare individuals for careers at intermediate levels. Specific examples of qualifications and programmes offered at the four providers (two FE colleges and two private training providers) are also illustrated in this section.

There is a wide range of programmes in IT, including Level 3 and Level 4 qualifications awarded by external bodies such as BTEC, City & Guilds, Oxford Cambridge & RSA (OCR), and others. BTEC Higher National Certificates (HNC) at Level 4, BTEC Higher National Diplomas (HND) at Level 5, and Foundation Degrees at Level 5 are common qualifications taught at a higher education level. In addition to these, a range of vendor-accredited certifications are available to provide both entry level and Continuing Professional Development (CPD) opportunities for IT professionals. Apprenticeships at Levels 3, 4 and 5 include a combination of the qualifications noted above, and provide a work-focused route to a career in IT at intermediate levels.

These qualifications are provided by a range of education and training providers. Level 3 qualifications are largely delivered by FE colleges and private training providers, whereas qualifications at Levels 4 and 5 are taught by higher education institutions (HEIs), as well as by FE colleges and private training providers.

3.2.1 ICT, IT and Computing qualifications

Qualifications related to IT are broadly categorised under IT and Computing, and IT user and IT professional categories (commonly referred to as ICT). For instance, IT user type qualifications offered by City & Guilds are generally focused on using applications such as word processing, spreadsheet processing, and emails.

Pearson offers BTEC Level 3 qualifications in Computing and in ICT (such as ICT Systems and Principles, and Information Technology). They also offer NVQ and competence-based qualifications in ICT, such as the BTEC Level 3 Diploma in Professional Competence for IT and Telecoms Professionals. It is worth noting here that ICT is only offered up to Level 3, with qualifications at Levels 4 and 5 focusing on Computing (e.g. HNCs and HNDs in Computing, and Computing and Systems Development).

Intermediate levels

It must be noted that 'intermediate levels' in educational terms do not necessarily match with how entry at 'intermediate levels' is defined in professional terms. Those qualified at Levels 3, 4, 5 and even Level 6 may only enter the job market at entry level support roles. As highlighted in this study, being qualified to a degree level does not, on its own, prepare graduates to occupy 'expert' or high-level technician roles. Indeed, those who have followed an apprenticeship route (up to Levels 3 or 4) may hold higher-level roles than those who may be qualified even up to a postgraduate level. This point is also illustrated by the networking company in our sample, which had recent apprentices occupying roles of higher autonomy and responsibility than those occupied by recent IT graduates.

On the other hand, as suggested by the training providers in our study, roles in certain areas of IT, such as cyber security or big data may require qualifications above Level 4 or 5. It appears that these roles perhaps demand a deeper theoretical foundation of computer science, requiring entrants to be qualified up to degree or even Master's level.

As is illustrated in later sections of the report, employers therefore may require a mix of skills, including at intermediate and degree level. They may prefer people at intermediate levels to fill certain roles that focus on practical application (such as support and networking) and others that require degree level ('academic') knowledge and understanding.

Vendor qualifications

In addition to apprenticeships and standard qualifications at Levels 3, 4 and 5, qualifications that can lead to careers at intermediate level are vendor qualifications or certifications for particular products (such as those by Microsoft or Cisco). There is a plethora of vendor qualifications, and certifications are often available at different educational levels. As will be further illustrated in later sections of this report, vendor qualifications enjoy high labour market currency and are often valued above standard qualifications.

Stand-alone vendor qualifications have been particularly prominent in CPD and career development. However, they also feature increasingly as part of standard qualifications, as awarding bodies and providers recognise their value. The importance of vendor qualifications/certifications was recognised by colleges and private providers, which had both embedded them in their courses:

> *… employers are not looking for qualifications, they're looking for certifications … and in actual fact a lot of new business that we've won, whether it be trial places for apprenticeships or whether it be high level apprenticeships, that's happened due to the fact that we're offering vendor certifications within our programmes. And then that allows naturally CPD opportunities for our staff as well to remain up to date in this very rapidly changing environment. (Representative, College A)*

3.2.2 Apprenticeships

While historically employers have tended to recruit graduates for IT roles (Brockmann, 2011), there has been an increase in the take-up of apprenticeships. Since 2012/13, there have been around 10,000 starts per year (Delebarre, 2015). Most of those have been at Level 3, although the biggest rise has been at Level 4, reflecting the increased demand for higher level (i.e. intermediate) skills, which is further discussed in Section 3.2. New degree apprenticeships (Level 6) were introduced in September 2015.

One of the recommendations of the Richard Review (2012) was that apprenticeships should be more focused on the needs of employers, building on a 'truly demand-led system'. As a result, the apprenticeship frameworks in England will be replaced by new apprenticeship standards from September 2017. The standards are being developed for each industry sector by a steering group of companies, based on consultation with employers more widely. Each standard lists a combination of technical competence; knowledge and understanding; and underpinning attitudes, skills and behaviours, as defined by employers. Assessment is based on a portfolio of work with an end test (graded as pass, merit, or distinction). So far, in IT, twelve new standards have been published, with many more in the pipeline.

The suggestion is that the old frameworks did not sufficiently reflect employer need, as they had limited or no input. The concern with the new standards, on the other hand, is with people being 'demonstrably competent'. The representative of Private provider A saw the labour market currency of apprenticeships enhanced due to proven competence:

… there was a danger with the frameworks that somebody could … pass their apprenticeship but it didn't necessarily mean they were competent at the end of that 12 months, because if they do it all through NVQ written work, that isn't necessarily proving your competence to be a technician or a software developer or whatever it might be. With the new standards because it clearly says they have to achieve these competences, and they have to know this knowledge … the currency of the apprenticeship is much higher, because you can literally pick them up and if I was an employer I would know that that apprentice is competent … because the standard is a bit more certain I guess in terms of what outcome you have to achieve. (Representative, Private provider A)

Importantly, all IT-related standards share a common core of knowledge and understanding that includes, for example, software development, network engineering, and project management. The Tech Partnership explained that the view that an apprenticeship relates to easily identifiable, narrow job roles, as may be the case in other sectors, was not justified in IT, where roles were complex and fluid. Interestingly, the demand for breadth of knowledge and skills was echoed by all the participants in our study.

The view across the sector is to be competent in any role within the sector, within an IT role there's a core of information you've got to have. To do programming you do need to understand something about project management, you do need to understand something about networks, and vice versa. So having a core is really good … And that is I think a very common view of apprenticeships outside of our sector, they do tend to be very, very simple roles. I think government hasn't quite twigged the fact that this is a very, very complicated sector. The roles are very high level generally, and I think not only are they very diverse, they change all the time. (Representative, The Tech Partnership)

The change to the new standards has been met with a mixed response. Some scepticism amongst FE colleges has been noted in the literature (Saraswat, 2016). The development of the standards has been criticised for a lack of SME involvement, and there is a perception that the standards themselves are overly simplified. The suggestion that standards make it possible to develop apprenticeships without formal qualifications is also a source of concern for providers, who argue for qualifications to be included in apprenticeships to facilitate transferability and progression (ibid).

Notably, the broader, occupational approach towards the knowledge element does not seem to be reflected in the definition of IT roles. The government requirement that standards need to relate to different roles, with no crossover or duplication between them, presents a particular challenge. This reflects of course a wider issue underpinning VET in England, whereby qualifications typically relate to narrow job roles rather than occupational areas, as in some other industrialised countries, notably Germany (Brockmann et al., 2010). Fuller and Unwin (2013) bemoan the weak link between apprenticeship and the concept of occupation in England, as the former relates to 'lists of skills' at different education levels.

The challenge is acknowledged by The Tech Partnership:

The simple fact that … we can't call a Level 3 Software Engineer a Junior Software Engineer, and a Level 4 Software Engineer a Senior Software Engineer, because that's too confusing, apparently. (Representative, The Tech Partnership)

Similarly, the large employer in our study was concerned that the new standards might be too specialised. The company has been using a generic apprenticeship framework that allowed them flexibility in developing different, and more rounded roles, which they achieved by rotating apprentices to different areas of the business. While the standards suited certain specialisms in the company, the interviewee expressed concern that they would be less suited for the more rounded roles they preferred in other areas:

> *… we want the apprentices … to be able to do application development, application test or infrastructure support roles so they will do probably those three and they'll probably rotate around loads of different areas and therefore we wanted a generic framework that will let them achieve that … some of these standards … they're very specific, probably still too specific even for us, and we actually we want to use a generalist approach as well.… (Representative, Large employer)*

3.2.3 Generalist versus specialist qualifications

As is suggested throughout this report, employers (both SMEs and large) have a preference for broader skills sets (see particularly Section 3.3). This is also reflected in the nature of qualifications offered at our sample colleges as illustrated below.

Several participants warned against early specialisation, and underlined the need for exposure to a broad range of IT areas in order to enable young people to identify their interests and strengths. The respondent from BCS explained that the current system made it very difficult for young people to decide what they want to do. He insisted that there was a need for programmes that enabled young people to explore their strengths on the basis of comprehensive information on the available opportunities and progression routes.

> *So if I do this where can I go, what is open to me and that's particularly attractive if you're starting off, how the hell do you know you want to be a software designer, you're good at IT, you did this that and the other. It can be very difficult to know I want to commit to an apprenticeship that does network engineering, how can you commit to that when you don't know? […] And I think perhaps that's the biggest gap at the moment is people in the first place to understand what opportunities are open, and getting them to commit to a specific job I think is a deterrent. (Representative, BCS)*

While he thought that generally apprenticeships would be a good way of identifying strengths, he warned that the new standards might be too specific as they required young people to 'sign up to a very specific role early in their career'.

It seems, therefore, that there is a need for provision that introduces young people to a number of areas in IT. However, this needs to be designed so as to engage young people, notably by establishing relevance through practice or work-based elements. The respondent from the start-up company told us that he initially attended a college course. He dropped out as he found it uninspiring, 'purely theoretical' and 'irrelevant to work'. He insisted that college could be a barrier to people if the content had no practice relevance. From his current perspective of employer he explained:

> *… so the skills that they're giving you just don't fit the bill, like you don't use any of it. Like they are a broad spectrum of things that you can do and none of it really, I guess there's … no focus really …. So, if I'm looking to leave college and get a job, like I have no relevance because you haven't really taught me software, so I can't*

get a junior software role, you haven't really taught me the technician competencies, so I can't really get a technician's role. (Representative, Start-up)

3.2.4 Qualifications taught at sample colleges and private providers

The approach of providing a broad knowledge and skills base was generally reflected in the qualifications taught by the colleges and private providers in the study, with specialisation at higher levels. As a general rule, full-time courses tend to be more generic, whilst apprenticeships prepare for particular job roles.

Both FE colleges provide a range of full-time courses and apprenticeships across different levels. College A provides full-time courses from Level 1 right through to Level 5. The distinction between ICT and computing is reflected in the difference in content between lower- and higher-level programmes:

Level 1 and Level 2, they do the basics of IT. Level 2, they start doing the basics of programming and networking. So you're moving from IT, where you're using the systems that have been created by other people, into computing where you're creating systems for other people to use. So that's again the focus that we have, we want to switch it from IT to computing as they progress through the levels. (Representative, College A)

Their Level 3 BTEC consists of two-thirds Computing and one-third ICT.

The approach taken by College A is to recruit young people on their full-time courses (usually Level 3) with the aim of moving them onto apprenticeships. Interestingly in the context of this study, they take around half their Level 3 students with poorer grades (and the students are then able to retake their GCSEs as part of the course):

So that's the goal, to take people from a position where they may feel that they're disadvantaged and don't have any options, to a position where they're in employment and are working towards the long term. (Representative, College A)

Underpinning the focus on getting students ready for employment is the close collaboration with industry. Both their full-time and part-time programmes are underpinned by their work on the industry forum (set up by a group of employers and VET providers to inform curriculum development and delivery in IT), links with a range of stakeholders, as well as their own research into industry needs.

The Level 3 BTEC involves placing the students in a company for two weeks:

The key focus of everything that we do is to try and get them ready for industry, for employment. So that means finding out what skills are needed and then putting that, integrating that into the curriculum, but also maintaining the links that we have with employers around the borough and placing students … into work experience for two weeks.… (Representative, College A)

It is notable that apprenticeships at this college start at Level 3, and we were informed that there is not sufficient employer demand at Level 2. At the same time, College A interviewees explained that employers valued taking on apprentices who had already undertaken the first year of the Level 3 BTEC. Representatives at College A were keen to stress that it was important to introduce students to a range of areas at Level 3, covering information systems, networks, and programming to help them make informed choices:

… no-one would go straight onto doing the Level 4, no-one will go straight into doing an apprenticeship. Most of our students start in … Level 3, that's 18 units over two years. By the end of the first year they will have covered information systems, managing networks, programming, they can see how they get on with that unit, and they have an idea after the year about which area they're good at, which area they're interested in, what career they'd like to pursue, and that's how we guide them. (Representative, College A)

Having secured an apprenticeship, the young people then tended to progress to Levels 4 and 5, studying the Higher National (HN) qualifications on a part-time basis. Apprenticeships were tailored to each particular job role, providing modules in line with employer-specific needs, with each apprenticeship constituting 'a unique programme of study for each individual person'. The interviewees insisted that:

It's hard to see a generic one for computing because there are so many different roles in so many different areas of industry that you cannot have [a generic one] because that might not suit the needs of the company, they might not want them to do that particular unit.… (Representative, College A)

HNC/HND courses in Computing run full-time or as part of Level 4 and 5 apprenticeships. Students can opt for particular specialisms, such as big data, web mobile or network security. The full-time programmes include a practice element in the form of a project:

In the project the students they developed an application or an app where they showcase their knowledge and skills that they have learned for their careers. (Representative, College A)

The highly flexible approach taken by College A seemed to contrast sharply with that in College B, which offers apprenticeships for specific routes including at Level 2. We were informed that Level 2 and 3 apprenticeships focused on hardware and prepared for roles including IT support and networking, whereas their Level 4 apprenticeship was 'more suitable for software'.

There was also no comparable approach of moving full-time learners into employment at College B. The college offers a Level 3 BTEC Extended Diploma with a choice of two strands in Year 2: networking, and software design and development.

Also in contrast to College A, students studying for HNs at College B do not necessarily progress from Level 3 qualifications in Computing and do not necessarily have a computing background. Therefore, both their HNC/HND and Foundation Degree programmes were focused on providing rounded qualifications. The HNC/HND seemed to prepare students for a wider range of jobs, and could help keep their options open and possibly specialise at a later stage. The interviewees explained that it was about introducing students to a range of areas which they can then explore:

Showing them that's what is out there. There's all sorts of things that they could go on and do. So I would say for any of those, there's elements of [this] in it but it is not going to …, I wouldn't have thought necessarily allow them to go straight into a job role… I mean certainly not something like cyber intrusion which is very specialised. (Representative, College B)

Whilst the Foundation Degree has elements of programming, web design and systems analysis, it does not on its own prepare people to occupy roles in these areas. Students at the college do not use HNs or FDs as exit qualifications, but progress to the Honours degree which is perceived to offer opportunities to students to specialise.

> … *we really try to make that as rounded a qualification as possible. So it's not really specifically for one area. Possibly that's why students then go on and top up, because then they can concentrate more on one thing that they know that they want to do. So our HNC students will do some web; they'll do some programming; they'll do computer systems so it's … not really focussing on one thing. (Representative, College B)*

It therefore seems that Level 4 and 5 qualifications can be used to prepare those individuals for roles in IT who do not otherwise have a background in IT.

The two private providers focus on skills development for school leavers and adults through a mixture of short-term courses and apprenticeships. In contrast to the two FE colleges, the full-time courses are specialised and tailored towards employer needs. For example, Private provider B offers specialist pathways, starting from Level 3, which were developed in response to local employer need:

> … *we were delivering skills at technician level … A-plus computer hardware technician skills, but employers and businesses wanted a wider set of skills around network infrastructure, server infrastructure back then, and now we've got things like cloud security and big data and those areas. But what we found … was we were delivering a very limited curriculum on hardware when industry was evolving and changing, and employers were asking for different skills. (Representative, Private provider B)*

At Level 3, they offer four pathways: network infrastructure (the most dominant of the four), server, cloud and storage, and security. The courses combine City & Guilds units with a range of vendor qualifications:

> … *at Level 3, we give students four pathways that we feel are skills areas in demand and areas of knowledge and skills we can transfer within the timeframe, and be confident that they would go into a role within London because there's that skill shortage. (Representative, Private provider B)*

The three pathways at Level 4 reflect a further level of specialisation: network solutions specialist, cloud specialist and infrastructure specialist, again with the network specialist being the most frequent route, taken by half of all learners. We were told that students chose particular pathways in line with what they believed to offer the best employment prospects.

It is notable that whilst the interviewee asserted that there was a demand from employers for the security specialist, this need was niche, largely from medium-sized employers who required more specialist security skills, whereas smaller employers needed infrastructure staff who knew 'a bit about everything'. The provider did not deliver the security specialism, and students were deemed to lack the skills required to study for the programme.

I think the reason security is not as popular to our students is perhaps they're more interested in ethical hacking, which we don't provide. And secondly, because at Level 3, if you haven't got strong networking or server skills, in my personal view, it may be a little bit harder to understand even the technical [aspects of] how to set up devices if you don't know what they necessarily do. (Representative, Private provider B)

Private provider A focuses on recruiting potential apprentices to their training and assessment programme and finding them employers. They provide a range of apprenticeships at Levels 3 and 4, including in technical support, networking, web and software development, and digital marketing.

All providers were keen to stress that their programmes included transferable and business skills that were sought by employers:

… there is a wider set of skills around your designing a network for this many users, this many computers. How will you make sure that it can handle that load? Do the documentation for that and do the interaction with the users, so almost like the business analysis skills. Make a project plan for it … Gantt charts, all of those things.… (Representative, Private provider B)

it's important that individuals understand the concepts of business because at the end of the day they're going to be applying these technologies in a business environment no matter what … so we do put business planning modules in there, business resources modules … so we've picked up modules that are not normally in the framework and imported them into here. (Representative, College A)

Similarly, all providers in the sample acknowledged the importance of vendor qualifications such as Microsoft, Cisco, Juniper and CompTIA (Computing Technology Industry Association); these were woven into programmes, particularly from Level 4 onwards. For example, College B offered Cisco CCNA (Cisco Certified Network Associate), CCNP (Cisco Certified Network Professional), and CompTIA (which seem to be particularly valuable in preparing individuals for networking roles), as part of their Foundation Degree. CCNA had also been offered as part of the Level 3 Extended Diploma. Interestingly, the college decided to remove this when students found it too challenging.

All providers offered a range of vendor qualifications as stand-alone courses for CPD.

3.3 WHAT ARE THE KNOWLEDGE, SKILLS AND COMPETENCES THAT EMPLOYERS ARE LOOKING FOR IN IT TECHNICIANS?

There was a general consensus that qualifications in themselves were not important and played a secondary role at best in recruiting staff. All said that they would train people in the technical skills according to their particular needs. Instead, far more important were having the 'right attitude' (being highly motivated and passionate), and 'aptitude' (being able to demonstrate a level of competence).

> *I'm more interested in finding people who are interested in technology, interested in knowing how something works … because I can teach them the technical aspects, so … with the trainees I've taken on and with the apprentices it's really more about aptitude and motivation than necessarily looking [for them] to have … a host of qualifications before we consider taking them on. (Representative 2, Large employer)*

Representatives of all SMEs in the sample insisted that it was important that people could demonstrate a basic level of knowledge, skills and competence. However, it was clear that qualifications were not perceived as a reliable indicator for these. Rather, being self-taught, with individuals having acquired skills in their own time, was considered highly valuable as a measure of both passion and aptitude, and evidence of this was a vital part of the selection process:

> *… show me what you've done, show me how you do it … let's talk on the projects you've built, how you built them, let's build a mini project … what I want to know is that you're very invested and passionate … your qualification doesn't allude to that … it doesn't inform me of that. And equally, I know some of the best developers in the world are self-taught … it's less what you know [and more] how fast you can learn. (Representative, Start-up)*

The representative of the non-IT SME expected apprentices to demonstrate a degree of competence as a critical foundation for the specialist training they provide:

> *So when we are looking at the apprentices particularly, I want to see … experience in coding. So whether it be building a family website or building a gaming website or whatever it is, all that sort of coding, developing games, I want to see what you've done, I want to see that you can do it…. there's an awful lot of training to bring people up to the specialist stuff that we do here … to train people up to that is quite expensive and they need to have a certain base level of competency. (Representative, non-IT SME)*

Similarly, the manager of the software development SME said they required basic coding skills, which they then would develop through in-house teaching:

> *'It's just like a general IT interest, IT fluent so they understand how machines work and how software works, and a keen interest in that area.' (Representative, Software development SME)*

3.3.1 Transferable skills

The other important criterion alongside competence and passion was that of transferable skills, including communication, team work and problem-solving skills. The large employer was different from the SMEs in the sample in that they did not require apprentices to have any prior technical knowledge, although transferable skills were crucial:

> *… so when we recruit we look at the transferable skills with individuals, so can they work in teams, can they solve problems, are they adaptable to change, demonstrate a level of client focus, you know, and that's absolutely necessary. The rest of it, the kind of real technical capability and skills they need to do their job, they learn on the job. (Representative 1, Large employer)*

Because many IT professionals work in client-facing roles, the ability to engage and communicate with customers was commonly singled out as critical.

The respondent from the start-up company insisted that what is important is that the person matches the particular work culture:

> *We'll look for another engineer who can keep up with my co-founder, like that's less of skill fit than it is a person, like within in a start-up anyway … I'm less concerned if you can, you know, write in 20 languages, I'm more concerned [about whether] you [will] stay to 11pm if need be, like that's the biggest indicator … no qualification … I wouldn't bat an eyelid at [this]. (Representative, Start-up company)*

3.3.2 Strong currency of vendor qualifications

Vendor qualifications and certifications were generally seen as far more important than standard qualifications. As illustrated in Section 3.2, this was also recognised by providers who offered them as part of their courses. To most of the employers in our sample, vendor certifications served as evidence that someone had up-to-date knowledge and was competent with a particular product.

The representative of the large employer pointed to the value of vendor qualifications as a professional standard (akin to a licence to practice), and the company was keen for their employees to obtain certifications:

> *I think we'd encourage it because it shows good professional development, it shows you've attained a standard and a level of knowledge and understanding and hopefully capability in doing something. It's something that we could potentially sell to our clients … if they've got a ITEL, you know, Version 3 Foundation Certificate, they've got a PRINCE2 Project Management qualification, if they've got a CCNA, you know, certified network technician qualification then the customer goes, "I'm confident that they know what they're talking about". (Representative 1, Large employer)*

The example below further illustrates the business case for employers who are vendor partners. Depending on the number of employees with relevant certifications, employers may achieve bronze, silver and gold partner status, and they will be able to purchase the products at discounted rates:

> *… what we found was the reason tech employers are asking for these certifications is because not only do they validate the person's knowledge, understanding and skills broadly, but also specifically on the product. It's also because they have a vested interest to have people certified in that because it helps them achieve more margins on their sales. (Representative, Private provider B)*

3.3.3 Apprenticeships versus graduates

Employers did not generally value qualifications obtained through full-time education. An important consideration here was the advance in technology, with knowledge quickly becoming out of date:

> … the nature of our industry is it's changing quite rapidly and so the second you've written a job description it's probably going to change within a matter of weeks and months … so … we don't recruit at all on the basis of technical knowledge or understanding because you can't, so you know, what you might have learnt two or three years ago could be obsolete, you know, very quickly.… (Representative 1, Large employer)

There were many suggestions that knowledge and skills acquired through full-time study (including at university level) were of 'the wrong kind' and that employers had to retrain individuals, who had to 'unlearn a lot of bad habits'.

> [Graduates] just don't have the skills that they need to do the job on day one, so then they have to set to and train them. […] The expectation of the grads to have the business skills that the apprentice has developed over the last three years is, frankly, unrealistic from somebody who has probably never been in work. (Representative, BCS)

By contrast, all employers in the sample stressed the importance of developing skills in the workplace. They highly valued apprenticeship as a model of learning and all but the recently founded start-up company employed apprentices. The workplace element was seen as crucial in preparing for IT roles, as, in the words of the representative of the Networking SME, 'it's a practical subject'. There was a strong sense that it was not possible to acquire relevant skills through full-time college education, as expressed by one of the SMEs:

> … they are learning practically within the office environment the coding skills they need which you don't really get with going straight through education. (Representative, Networking SME)

A critical advantage of apprenticeship was therefore that it enabled employers to train people in line with their specific requirements. The college element of an apprenticeship was valued where employers felt that it provided fundamental knowledge which was relevant to their needs. Thus, while the two companies in our sample with apprentices at College A (the Software development SME and the Non-IT SME) both dismissed the value of qualifications generally, they valued the BTEC and HN qualifications their apprentices took as part of the apprenticeship, particularly because they had an input in the modules being taught and because they were relevant to their needs.

> … what they are studying is all relevant, well, lots of it is relevant to what they're doing here. It's experience in coding, it's writing specifications and understanding specifications. The college come in and we discuss, we have reviews every couple of months, and we discuss how they're going and what they need to do for the next review, and which modules they're going to study next term or next year. (Representative, Non-IT SME)

> … a good thing with [College A] and why we work closely with them is that they offer a few coding courses within the Level 3, 4 and 5. So that gives them the good fundamentals which are needed to expand on their current basic skills […] You need

to have some sort of qualifications to have the understanding, basic understanding and knowledge, which is obviously the Level 3, 4 and 5 courses. And from there you've got to build up your experience in the actual workplace. (Representative, Software development SME)

It was interesting that these respondents also indicated how much they valued the initial full-time college element at College A as providing a basic level of understanding. The following quote seems indicative of the close collaboration between the college and local employers, who are able to specify their particular requirements when taking on apprentices (e.g. they wanted a C# developer and were looking for someone who had done relevant units in college):

… they didn't have to be in-depth, they could just be basic units, but just for them to understand the sort of foundations of the environment and the language. (Representative, Software development SME)

The suggestion that employers do not value qualifications *per se* was also underlined by the large employer in our study. Apprenticeship here served as an entry route (similar to graduate training) and was not seen as an end in itself – it was not the qualification that was important.

Also, the large employer valued the breadth of the apprenticeship (they were still using the old framework) to identify talent and for the apprentices to become interested in a particular areas. The benefit for the employer was that apprentices were highly motivated and could be placed according to the needs of the company:

… different businesses will sponsor them through their apprenticeship programme, so they aren't just exposed to one business, they have a much broader exposure, which should help them identify and plan their career development […] so for us it's very important because it also allows us take these motivated people in, get them exposure technically on product areas where we might have some gaps.… (Representative 2, Large employer)

Following the apprenticeship, and having had exposure to different areas, the apprentices were then expected to specialise.

Apprenticeship was regarded as a highly appropriate way of developing new entrants, particularly as apprentices would take vendor qualifications as part of it. Also, apprenticeship enabled a progression route right through to Level 5 and, with the new degree apprenticeships, Level 6. The respondent from Private provider A welcomed this and underlined the possibility to achieve professional recognition:

… traditionally, in our sector […] most apprentices come in at Level 3 and then progress to Level 4. Obviously now we've got degree apprenticeships coming in, and in a lot of other sectors they've gone even further and you can go all the way through to … you can become a qualified Accountant, a qualified Solicitor, a qualified HR Manager, all the way through an Apprenticeship, and do your professional qualification at BCE, PD or CIMA or whatever it might be in your space, and still get your professional qualification alongside … built in, as part of your apprenticeship. Fantastic! (Representative, Private provider A)

3.3.4 Experience is key

Experience was valued above all else, and there was common agreement that this counted for more than qualifications or even certifications. Experience was gained in the workplace, and over many years:

… the certification, the classroom education and the shadowing that you do is really only the start of the process. It's really by doing the calls, by being in front of the client that you actually build your knowledge on it […and] sometimes the right skilled engineer in front of the client is going to be the person who has been fixing that for 20 odd years and knows the system inside out and will have some qualifications, but their knowledge is far greater than qualifications that they could now get because of their knowledge and how long they worked on the system. (Representative 2, Large employer)

3.3.5 Recruiting raw talent

Several employers indicated that, rather than bringing in qualified professionals, they preferred to take on 'raw talent' whom they could train according to their own specific needs. For the large employer, this reflected a shift in their recruitment strategy:

… with us not taking on as many professional hires, we've invested more in apprentices and trainees to bring them in and get the exposure on the equipment that we would like them to have rather than necessarily bringing in more experienced hires who would have certifications and qualifications. (Representative 2, Large employer)

An interesting example was provided by the manager of the Web design SME, who explained that they had changed their recruitment practice as a result of a negative experience with graduates:

… you almost had to hand hold them through every single process. And so we had taken on two developers who within a year of taking them on we had to let them go because they just weren't able to essentially complete the work and yet they were probably the most highly qualified of the people in our staff. So what the decision from that point onwards was let's not just go on qualifications. Let's mainly go on experience. So obviously, show us what you've done, explain to us how you achieve that.… (Representative, Web design SME)

Similarly, the manager of the Networking SME explained the importance of growing their own talent in order to suit their particular needs:

The strategy is [to] find very, very good people and get them to be role models for people coming up into the organisation. And the reason we do that is because if you approach talent development in that way you get a much richer skill set and much more capable people than if you just buy in expertise, because if you buy in expertise you always get expertise in somebody else's image whereas actually if you grow your own expertise you get expertise in your image and does things the way you want to do them. So your ability to set standards is much, much greater if you have that approach of recruiting raw talent and developing it into exceptional people. (Representative, Networking SME)

The staff who are the experts of today had themselves grown through experience. At the Web design SME, the senior web developer (who is now the expert) was brought in with only two years' experience. While he did have a degree in computer science, it was what he had done in his spare time that persuaded his manager to take him on ('web design was his hobby').

As indicated by the employers in our sample, apprenticeship provided a highly appropriate route to develop 'raw talent'. This is also in line with evidence from our sector level bodies that there has been a shift in recruitment strategies from recruiting graduates to increasingly taking on apprentices, as discussed in Section 3.2. The large employer in our study explained that while they had discovered the benefits of apprentices, they preferred a 'mix of talents'. Thus, they still valued the academic knowledge and 'maturity' of graduates which were required for certain roles. We were told that graduates tend to move more quickly into strategic roles, for example.

There is also a case for having a balance of different experiences, as represented by age:

> So the [older] technologies … such as mainframe … the expertise and experience is typically with longer serving [employees] and you pick up far more from working alongside them than just reading old manuals or old books. For supporting newer infrastructure or areas such as mobile, then actually because the current generation … of intermediate professionals has grown up with it, are very familiar with it and … and [it] may almost be reverse mentoring and helping the more seasoned professionals get to grips with it as well.… (Representative 1, Large employer)

3.3.6 Skills gaps

Overall, and somewhat surprisingly, we found little concern about skills gaps. In line with the recruitment strategy outlined above, employers felt that where there were gaps, they would bring in new staff and train them up. The respondent from the large employer explained that the well-known gender imbalance in the IT industry was of far greater concern:

> I think the bigger challenge is more around diversity and wanting to encourage, for instance, females into technology, that's the biggest challenge for any employer. Skills gaps, well as I say, most of what we do is, you know, we'll teach you once we get you in, so long as you can demonstrate an interest in that area then we can build the skills in that area because you want to learn. I think, you know, the rate of growth of areas like cyber, and trying to get security specialists and so on, well, you know, you have to build those skills rather than just bringing in people who already have that knowledge. (Representative 1, Large employer)

However, some of the SMEs reported difficulty in recruiting, particularly at the higher levels, because of the specialised nature of their businesses. For example, the interviewee from the Networking SME explained that it had taken them six months to fill their head of network role due to the specialist skills requirements.

3.4 HOW IS THE UNDERPINNING KNOWLEDGE REQUIRED FOR THESE OCCUPATIONS DEVELOPED IN A CONTEXT OF RAPIDLY ADVANCING TECHNOLOGY?

Unsurprisingly, keeping knowledge and skills up to date was seen as essential by all employers. It is noteworthy that this was regarded ultimately as the responsibility of the employee, although companies would provide necessary resources. Keeping up with technology was very much part of the organisational culture. Staff were generally assumed to be committed and motivated to do this of their own accord, including in their 'own time'. For certain areas in IT, such as web design, this was also about originality and creativity.

For the large employer in our study, keeping up with technology was an essential part of CPD. Employees were expected to spend a minimum of 40 hours per year on their professional development. To that end, the company had put in place a series of resources, providing information on developments across the company and industry-wide, involving learning in-house as well as off-site. As seen earlier, the employer encouraged the take-up of vendor qualifications.

Similarly, for the Networking SME, a commitment by staff to keep up with technology was part of the 'attitude' the employer was seeking in employees.

> … *because actually people with the right attitude will have the flexibility in order to develop their understanding of technology and respond to new technologies and not seeing them as threats but seeing them as opportunities.… (Representative, Networking SME)*

While staff were expected to take the initiative, it was the role of the senior management board to provide 'strategic direction':

> … *define the strategic direction of people […] so that they can develop their skills in response to direction of travel […] The issue in the tech sector is not just the speed of development, it's the proliferation of technology, and so actually what you don't want is for people to learn everything about all technologies all the time […] What we have to do in the strategic team is to be able to say […] this is the narrow field of expertise that we're going to focus on and we're going to be really really good in this narrow field. (Representative, Networking SME)*

The respondent of the Software development SME also indicated that remaining up-to-date with technology was part of day-to-day practice:

> *It's all about being 'in the know' to be honest with you. So it's important to always read tech articles. The other day we were having a discussion in the office about five new programming languages that have been made, one by Google for example, and we've all just had a little look at them, not gone into the detail, but it's just important to acknowledge what's coming out, what's new, what could be trendy. I know a lot of the guys as well do other programming languages in their own time so they expand their knowledge all the time. (Representative, Software development SME)*

Vendor qualifications played a vital role in technicians' CPD. As explained by one provider, unlike standard provision, vendor qualifications were regularly updated in line with technology, something that was reflected in their strong labour market currency, which was the reason providers had integrated them into the standard courses. In addition, all our providers offered a host of stand-alone vendor qualifications. These were taken up by individuals already in employment as part of their CPD, or as preparation to gain employment. As expressed by Private provider A:

> *… you can still go and do more certifications … as I say we have a commercial training business, so we have people that we process who will come back and do the next version.… (Representative, Private provider A)*

There was little suggestion from our participants that a certain level of underpinning theoretical knowledge in initial education would equip learners for keeping up with technological developments. Indeed, as seen in the previous section, employers on the whole were suspicious of the theoretical content of full-time courses, including at degree level.

However, two respondents (one from College B, one from the BCS) suggested that arguments concerning knowledge becoming quickly obsolete were exaggerated and inappropriate.

As we will see in the next section, the respondent from College B explained that certain core technologies, notably in networking, have remained the same. Thus, while some technologies, such as applications, may change rapidly, others do less so.

However, it is also the case that theoretical knowledge and underlying principles (such as maths and algorithms) taught as part of degree courses do not change. As the BCS representatives explained:

> *… there is some [knowledge] that absolutely will not change, so the theory behind a lot of it, it won't change, it is the same. And so even though employers, everybody loves to say, 'We're special and we're different and we're unique and we need everything tailored, actually there are some real core fundamentals that are not special and unique and tailorable, and they won't change over time, so that's your breadth bit and everybody needs those. (Representative, BCS)*

3.5 HOW DO IT TUTORS PERCEIVE THE CONTENT AND STRUCTURE OF THE COURSES THEY TEACH, AND HOW DO THEY SEE THEM FITTING WITH EMPLOYMENT DEMANDS?

This chapter draws on interviews with tutors, programme co-ordinators and managers at the two FE colleges and two private providers.

The tutors and managers perceived that the courses they teach may be out of date. However, keeping them up to date can be complex and demanding. Programmes that prepare students for external awards were perceived to be rigid and difficult to adapt. However, a large range of units offered as part of the programmes provides some flexibility in helping students to specialise.

3.5.1 Currency and relevance of qualifications

The rapidly-changing technology was recognised by most interviewees, and the challenges associated with keeping the qualifications up to date were highlighted. Whilst IT is a fast-moving area, colleges have to teach to external curricula for qualifications below HE. College B also pointed out that any changes to the Foundation Degree required working with the validating university, which was a slow and demanding process.

> …we are so limited in what we can deliver because you've got to follow a qualification that's [publicly] funded. (Representative, College B)

> Because the qualifications themselves usually … are behind what is actually happening in the real world and we can't do anything about that because we have to teach to the syllabus. So we know that a lot of the stuff that we teach now perhaps is already out of date. (Representative, College B)

However, one interviewee illustrated the point with reference to networking that while certain aspects of technology do change rapidly, the core principles remain almost the same.

> … the core technologies [in networking] haven't really changed that much, the way it's used, the way it's applied … the networking kind of fundamentals haven't really changed. All that's really changed is the bandwidths of the kind of communication links and the processing power of the machines that are onto the network. (Representative, College B)

As we already saw in Section 3.2, all our providers incorporated vendor qualifications into their standard programmes. These were viewed as a means of developing relevant, up-to-date knowledge beyond the constraints of the standard qualifications, as vendor qualifications were constantly updated in line with technology:

> So that's why we go down the route of certifications … because modules are written by awarding bodies [and] may be four, five years old. And we're allowed to change 10% legally of that … but what we do we go beyond that and we embed our certifications into our curriculum … and actually those certifications are always aligned with what … industry wants at that point in time. And that's the way we're able to keep our students up to date…. (Representative, College A)

The respondents from College B also highlighted the specialist knowledge provided by vendor qualifications:

What we found was the reason tech employers are asking for these certifications is because not only do they validate the person's knowledge, understanding and skills broadly, but also specifically on the product. (Representative, Private provider B)

Crucially, the relevance of programmes appeared to depend on the provider's link with employers. College A (much more than College B) seemed highly proactive in ensuring the curricula of both their full- and part-time programmes were relevant to industry. This included fostering close relationships with employers, e.g. through industry fora; being able to draw on their own research, e.g. on technology developments – they had a number of research-active staff; as well as collaborations with other bodies, such as the local employment agency who provided them with information on skills gaps and training needs, and the Tech Partnership. In addition, tutors kept their own knowledge and skills up to date through undertaking vendor certifications themselves. Vendor certifications were viewed as helpful to gain employer trust and confidence – both through demonstrating that staff had achieved these certifications but also through preparing students to sit the exams.

… and in actual fact a lot of new business that we've won, whether it be trial places for apprenticeships or whether it be high-level apprenticeships, that's happened due to the fact that we're offering vendor certifications within our programmes. And then that allows … CPD opportunities for our staff as well to remain up to date in this very rapidly changing environment. (Representative, College A)

As we saw in Section 3.2, College A focused on moving their full-time students onto apprenticeships. IT was regarded as an area that above all demanded practical knowledge and application. Apprenticeships were therefore particularly helpful in offering relevant work experience to young people whilst they studied towards their qualifications. Apprentices also have more options for continuing learning and keeping up with technology, both through the college element and through training provided by the employer.

Apprenticeships were also seen as advantageous over university degrees in terms of preparing people for employment. There was a sense amongst providers that graduates lacked practical knowledge and application. Technology changes rapidly, and by the time students graduate from university, their learning is already obsolete:

… half the stuff that the graduates are learning is redundant by the time they're graduating, because technology changes, …. and it's very hard for a university to keep up and train people and make sure that they're fit … I would argue in many ways you're better off doing an apprenticeship and getting practical skills in the workplace, than going to university and getting an IT degree. (Representative, Private provider A)

There is an argument for saying in the IT and digital space that they would be far better off going through an apprenticeship with a reputable organisation and getting three or four practical years of experience.… (Representative, Private provider A)

In addition, apprentices can be trained according to the needs of employers, whereas with graduates there is a need for 'unlearning' and reskilling.

> *… you can mould that individual into whatever you like. When … graduates come in, they have their own methods of doing things, they have their own school of thought and whatever else and they have to reskill them and retrain them, although they've already got a degree. Here we're developing people in-house in the styles that you want to know, the systems that you want them to work with, so they're more productive in that same time period and they can be more of an asset to the organisation. (Representative, College A)*

3.5.2 Qualifications and the roles they prepare for

We saw earlier that apprentices as well as graduates commonly start in (junior) support roles, albeit that these may involve a broad range of responsibilities. They then specialise and while apprentices typically stay in technician roles, graduates might take on more strategic responsibilities more quickly. The providers in our sample were broadly in agreement as to what roles their programmes prepared students for.

Interviewees at College B explained that qualifications obtained through full-time study without relevant work experience (e.g. their HNC, HND and Foundation Degree programmes) would only provide access to 'entry level' junior roles.

Even where these qualifications included a specialism (their Level 3 BTEC Extended Diploma provided the option in Year 2 to specialise in either networking or software design and development), it was felt that the programme prepared students for junior roles in these areas:

> *I would say some sort of junior role. [BTEC Level 3 students] do a mix of units and in fact some of our second years make a strand choice so either networking or software design and development. So if they've made that strand choice then I would expect them to go into some sort of junior web design role perhaps. (Representative, College B)*

The specialist pathways at Private provider B were thought to prepare students for roles in the particular areas. For example, the Level 3 infrastructure qualification largely prepared individuals for roles such as network analysts or network engineer. However, the interviewee remarked (in line with our discussion in Section 3.1) that in SMEs these roles would typically be more 'rounded' and might be slightly more generic, with titles such as IT support engineer or IT support analyst.

The representative of Private provider B further explained that those qualified at Level 4 typically occupied roles of network engineers or consultants, with responsibility for designing networks. Those with Level 4 infrastructure (server) qualifications commonly held titles such as server engineers. Subject to relevant vendor accreditations, the job title might then specify the particular product they specialise in, for example, Microsoft engineer.

As was seen in Section 3.1, the system of first-, second- and third-line support is associated with varying levels of responsibility and experience. The respondent from Private provider B suggested that Level 3 students would tend to occupy second-line roles and Level 4 students third-line type roles in networking. However, as illustrated by his quote on page XX, he also suggested that the level of responsibility was dependent on the number of years of experience, as well as the level of education.

In a similar vein, the respondent from Private provider A believed that job titles associated with Level 3 and 4 qualifications included data analysts, project managers, engineers, and field engineers. At Level 4, the titles were more related to design and architecture. However, he suggested that individuals with qualifications at Levels 3, 4 and 5 would typically go into first- and second-line support roles initially, predominantly dealing with calls and fixing problems remotely. Having done these for two to three years, they could then progress to more advanced roles, including visiting clients on site.

The respondent from Private provider B further argued that progression from Level 1 to Level 4 roles required people to attain certain vendor qualifications.

I think to move from Level 1 to Level 2 they have to pass their Cisco CCNA, because they're a specialist networking security company, so they expect them to demonstrate levels of competence, but also have certain vendor or professional qualifications that support them through their journey. (Representative, Private provider A)

Notably, higher-level apprentices (i.e. Level 4) were perceived to hold high levels of responsibility and to be able to work autonomously.

The higher apprentices are absolutely able to take decisions, and probably start to be mentoring people and running mini projects and those sorts of things …. If you think about a project being planned, designed, tested and all the rest of it, and that kind of cycle, certainly the Level 4s should be much more heavily involved in the design and strategy, and not just the first bit, the implementation. (Representative, Private provider A)

3.5.3 Skills needs – IT areas of greatest demand

In relation to intermediate-level skills, areas that were identified by our providers as those with the greatest demand for skills included networking and programming:

… if the network breaks, if people can't connect to their internet, if they can't send emails, then they need someone there to fix it. So the majority of jobs that students go into [are] network administration, network security. (Representative, College A)

… systems have converged, everything is coming together, and actually what's keeping that all together is network protocols … in order for convergence to occur you need programming…. (Representative, College A)

However, College A were quick to stress that the demand in these areas was at the higher levels, and they encouraged progression of their apprentices:

The main Level 4 and 5 that's where that demand is … it is network security, networking, programming, those are the areas they're initially going into. (Representative, College A)

… a Level 3 year 2 student could go into an IT support role but that's becoming less and less likely because what's happening is organisations are taking on apprentices, or individuals even with degrees are going down that particular route and getting those jobs. So what's actually needed and what we're doing and what we're seeing is that students are staying in education longer to get up the ladder a bit higher, at least to Level 4, Level 5 qualification, HNC or HND. (Representative, College A)

Providers, such as College A and Private provider B in particular, stressed that they were keen for their programmes to reflect the needs of the industry. For example, College A suggested there was little demand in the area of hardware:

We've built up our programmes on the type of industry that we have around us, and even the type of competitions that we take part in, WorldSkills, because they're networking and security type of competitions … there's very few hardware jobs out there, they're mainly abroad, so hardware components like a PC gets assembled somewhere else and it's just brought into the country. (Representative, College A)

Similarly, Private provider B had identified growth areas such as cloud computing through engaging with employers. They had developed their specialist pathways accordingly:

The three areas that are coming through to us from our employer focus groups are cloud skills… that's typically coming from IT solutions providers, because you've got things such as Amazon web services and all these new technologies coming out, and their customers are asking for them. So they've got a lack of skills there. The other one is security … intrusion prevention … and the third one is the management skills and the design skills … and the other one I didn't mention, partly because we don't have a curriculum yet here, but we're considering it, is software development and coding. (Representative, Private provider B)

Cyber security was perceived to be an area for potential growth by both FE colleges as well as Private provider B. College B was keen to introduce more cyber security elements into the curriculum, although this was largely in response to student demand.

The interviewee from Private provider A suggested that while security was a component integral to all IT roles, cyber security as a specialism was not as significant as often assumed, although, like the other provider in the sample, he also felt it to be growing as a skills area:

I don't think cyber security is as big as people think it is because … security is relevant to every job that everybody does. If you look at some of the professional qualifications, they have security aspects built into them [e.g. COMPTIA]. Some of the bigger organisations … particularly in the financial services sector, are obviously taking on security specialists but your average organisation hasn't got those sorts of specialists. They will all have the network engineers, infrastructures, data analysts and those sorts of things typically, but I think cyber has the potential to grow, big data has the potential to grow, but there will always be a need for technicians. (Representative, Private provider A)

Finally, we found that certain specialist areas, such as big data, were thought to require higher level skills:

With regards to the big data stuff that we're doing that's more for our Level 5, Level 6 students … but they sometimes need to do further study as well, they might do a Masters in data science or something. (Representative, College A)

This was in agreement with the response from the interviewee at Private provider B who argued that big data required stronger foundations in computer science and was a specialist programme.

3.6 WHAT ARE THE LEARNERS' VIEWS ON THEIR IT TRAINING COURSES AND RELEVANCE TO THE WORKPLACE?

This section predominantly draws on interviews with current or recent apprentices at four companies. One of these companies was the large IT employer in our sample, and three apprentices took part in a joint interview from this company; two of these were current apprentices at Level 3, and one was a former apprentice who had recently completed Level 3 and Level 4 apprenticeships. Another was a large non-IT company, from which one apprentice was interviewed, although this company was not involved in the study otherwise. The remaining two companies were SMEs, of which one specialised in IT and two apprentices (one of whom was a recent apprentice) were jointly interviewed; while the other company was a non-IT organisation, and one apprentice was interviewed as part of the study.

3.6.1 Perception of apprenticeship

There was evidence that general awareness of apprenticeships is low. Most of the young people had had little knowledge of apprenticeships prior to starting them. A common reason for embarking on an apprenticeship was that they had a preference for hands-on work, and valued the opportunity of 'starting a career' rather than going to university.

> *You've got to do something and I knew that uni wasn't for me because I didn't really like classroom learning and things like that. So yeah, I was just kind of looking at all the websites and then I thought, okay, there's obviously apprenticeship or a job that I don't really need many qualifications for, so I looked at the apprenticeship because I wanted a career and not just a job. (Apprentice 1, Large employer)*

> *I mean it was either going to university or doing an apprenticeship and I just thought to myself that I would like to kind of start my career earlier rather than going to university and spend another three to four years in education so that was one of main drivers I think. (Apprentice 2, Large employer)*

Interestingly, the young people's views reflected widely-held negative perceptions about apprenticeships:

> *When I were last looking five years ago there wasn't really that many apprenticeships out there, they've only just kind of rocketed in the last couple of years …. It was technical, more plumbers and builders and things like that. (Apprentice 1, Large employer)*

> *And apprenticeships had a stigma attached to them I think for years, don't you, you get the minimum wage – well not even minimum wage.… I think a lot of people think they'll just be making tea and stuff like that. (Apprentice 3, Large employer)*

> *I suppose at first, initially, I wasn't too keen on the idea of apprenticeships. I kind of saw them as a way that employers get, you know, cheap labour and often don't teach a lot…. I thought, "Oh someone's just going to use you, the government's going to pay for you, the company's not paying for you," and all that. They just want cheap workers. (Apprentice, Non-IT SME)*

3.6.2 Prior knowledge of and interest in IT

Most of the young people in our sample had developed a keen interest in computing prior to starting the apprenticeship:

I had an interest in IT, I used to build computers when I was young, like quite hands-on and then, yeah, my friend did a year here as a placement […] and I just applied because I wanted to … like concentrate on a career as opposed to just, you know, some education. (Apprentice 3, Large employer)

I did a lot of computer stuff, no actual studying or qualifications, but building my own support … doing my own stuff at home, families, friends. Pretty much love computers, always got into them. I did the apprenticeship on Level 3 Networking. Before that, the most knowledge I had of networking was you plug a cable in and you get internet. (Apprentice 1, Networking SME)

The apprentice at the non-IT SME had started learning programming at a young age independently through open source software. As seen in Section 3.3, his employer also confirmed that they valued candidates who had learnt software development through such sources over formal qualifications.

Since leaving school, I was on my computer a lot … came across an open source service software for a game actually, and I found it fascinating reading how everything worked, so I kind of learned it, the programming, just through messing around with that open source software, playing around with it, seeing what I could do, seeing how it all worked. (Apprentice, Non-IT SME)

However, not all apprentices had prior knowledge in IT, and, as seen earlier, some employers rated transferable skills, such as communication, as more important. The apprentice at the Networking SME suggested that he was offered an opportunity by his employer on the basis of his 'attitude' rather than knowledge of IT.

… not having any background in IT whatsoever, so it was just more like an opportunity which I took to and grasped … If you asked me before my apprenticeship, did I know how to switch a computer on properly? Just about. So I wasn't very IT savvy when I started. (Apprentice 2, Networking SME)

… he looked at me not just as a young kid sitting there, but he looked at me with a lot of oomph like, "Do you know what, this person's going to do something", you know, he opened up a door for me, and said look, "What I could do for you"… He didn't turn me away, he didn't say you can't have a job here because of this, because of that. He … gave me that opportunity and that was I think one of the things that kept me on. (Apprentice 2, Networking SME)

Apprentices were generally not informed of the specialisms and choices available to them when they started their apprenticeships. Those who were progressing from Level 3 to Level 4 apprenticeships had prior experience and were better able to choose their areas of specialisms. For new entrants, the starting-point of their apprenticeship was often the 'love of computers' or a vague idea that they will be doing 'something in IT'. As is argued in the report, any educational programme would have to include exposure to different areas in IT to enable young people to make informed choices about their apprenticeships and future progression. College A exemplified some good practice in this regard by encouraging their full-time students to consider progressing to a Level 3 apprenticeship after completion of the first year of their Level 3 programmes, and by matching them up with employers, based on the young people's strengths and merits. The apprentices from College A also valued the guidance they received from their tutors in directing them towards an apprenticeship:

… one of my programming tutors, was actually for a game development subject, recommended me to this company saying that it was similar to the kind of stuff that I was doing well in at college, so he set me up with an interview … To be honest I didn't know much about apprenticeships, I just took my college tutor's word for it. (Apprentice, Non-IT SME)

All apprentices described the recruitment and selection process as highly competitive and rigorous, with apprentices being interviewed and tested multiple times:

We all went to a big test centre and basically got made to [do] a load of different tasks. They were obviously picking things out about each person, like how they were doing. But quite a long interview really, something like 8 in the morning until 4.30 in the afternoon. And there's interviews and presentations … quite a rigorous assessment process. (Apprentice, Non-IT large employer)

3.6.3 Roles of apprentices in the workplace
The two Level 3 apprentices at the large IT company occupied front office support roles and first-level support for hardware.

I basically just help fix and answer questions for all our … like we've got … major like banks and retail sector, so and do you know mainframes … so basically the software that runs on that….Yeah, any questions they have or any problems with it I try and fix it. (Apprentice 1, Large employer)

By contrast, and in line with the discussion in previous sections, apprentices at the SMEs in the sample occupied roles that seemed broader and that included the IT support function as just one element. The quote below by the Level 4 apprentice at the non-IT SME illustrates the fluidity and breadth of roles in SMEs. His official job title was that of a 'Technology Apprentice'. Whilst his primary role was programming, he also had a general technical support function within the company, simultaneously fulfilling the roles of 'generalist' support as well as 'specialist' technician. His responsibilities included creating and expanding databases, web programming, communicating and supporting clients, as well as general IT support:

My role at the minute is to reprogram a CD activation serial number kind of system where customers contact you with their serial number and you need an activation code to give them so they can use the product … it's not just all programming, if people have computer problems I go and help out with that … so it's kind of helping out with anything IT-related, just like any kind of IT support person would do. (Apprentice, Non-IT SME)

It is notable that apprentices in SMEs fulfil highly-specialised functions within those broader roles, reflecting the specialist nature of the companies that employ them. The two apprentices at the Networking SME specialised in network programming and telephony programming, respectively:

I do support, I do remote work from the office, I configure the aerials we use, because the company uses aerials to provide an internet service, that's a special thing we do. I can configure them, I'm basically skilled in them. I can configure the routers and switches that we use. Very basic, not the really advanced stuff yet, which I'll be getting there to. I can basically go to site and probably troubleshoot their connections, get them back online. And wireless issues, I can kind of delve my hand in.… (Apprentice 1, Networking SME)

I do more of the telephony programming. Yeah, so I'm doing mainly like focussing on the VIA Systems, because these are like hosted telephonies that work through the network itself. So you've got to program these to actually be able to work with the networks, you've got to know how to do it, there's certain commands. Certain applications you've got to know how to use and you've got to train yourself on it. (Apprentice 2, Networking SME)

3.6.4 Responsibility and autonomy

All the apprentices in our study, regardless of size of employer, asserted that they had high levels of responsibility and worked largely independently. Similarly, they all felt that they were classed as members of staff in the same way as other employees of their companies.

… no-one out there would know you're an apprentice unless you told them.... (Apprentice 1, Large employer)

I've never felt like an apprentice, I've always felt like a proper member of the team. You know, you're given the same responsibilities as any staff, you know, you're given the same priorities as any staff … any mistakes you make … it's your full responsibility.… (Apprentice 2, Networking SME)

The apprentices at the large IT company perceived that the company was investing in them because they wanted them to be part of the business. The apprentices were provided with complete exposure to the business, and were trusted to do their jobs without supervision:

… there's a team of three of us and both of them were out yesterday, so I was on my own and so I was dealing with customers and things, and you're telling them things to change on their system so you could potentially take the whole system down, so they obviously trust us quite a lot, and that says a lot about how they have built up our skills [so] that we're able to do that without any supervision or anything. (Apprentice 1, Large employer)

Apprentices in SMEs certainly seemed to work with high levels of autonomy and responsibility, suggesting that, while they would seek direction, they would be capable of executing tasks themselves. For instance, a Level 4 apprentice at a non-IT SME worked mostly independently and, being part of a small team, could provide some cover for the other two 'senior' members of the team for tasks such as liaising with clients who needed to activate the CDs sold by the company.

… I do pretty much everything independently. Obviously when I'm doing the programming and creating the database I need to speak to them about what spec they want and what exactly it is they need to achieve. I mean I'll get on with the work myself, and you know, I don't need help programming. (Apprentice, Non-IT SME)

Interestingly, the apprentice at the large non-IT company contrasted his experience of his Level 3 apprenticeship with that at the small IT company. He asserted that he felt 'more challenged' in his apprenticeship at the small company in contrast with his higher-level apprenticeship at a large non-IT employer.

[at the SME] there was three of us there, basically dealing with all [the] tickets … so you had big responsibility, if you didn't do work they'd notice.… But like [in the large company] you think there's so many people that are busy working and … I

don't feel that they really have a lot of time for you … I just don't feel like I'm being challenged enough. (Apprentice, Non-IT large employer)

The interviews also illustrated that apprentices in SMEs may progress quite quickly, even during their apprenticeship. The Level 4 apprentice at the large non-IT company had done a previous Level 3 apprenticeship with a small IT company that specialised in networking. His role there had started with resolving faults and, as he gained more experience, he was sent to customer sites for installations:

At first [I was] only sort of like dealing with like basic DSL faults, so those sort of easiest … And then as I got, sort of, a bit better they started like letting me look at the firewall stuff. And yeah, they gave me a bit more access, because like at first, I'd only have access to show commands and stuff on Cisco so I can only look at the configuration and I couldn't do any changes. But I think once they had a bit more trust in me they started letting me do more. (Apprentice, Non-IT large employer)

Similarly, a recent Level 3 networking apprentice at the Networking SME had initially started in 'first-line' support and had moved to 'third-line' on completion of his apprenticeship.

From moving down from being a first-line client service support, I am now a third-line telecommunications engineer. So I do a lot of the mainstream programming of the phone systems, delivering a lot of the projects, installations. It's a big role and responsibility, you know, providing that I'm the only sort of telecommunications engineer [at the SME] at the moment. (Apprentice 2, Networking SME)

The apprentice explained how he progressed through the system of escalation (also described by his employer in Section 3.3), with each level requiring greater technical expertise and affording higher levels of responsibility:

I've moved up to Level 3, but more of a junior level of Level 3. So I'm still sort of expanding my knowledge. So obviously you've got your Tier 1 support who… pick up the phone, drop the phone. So that's where I started. And then … you've got second-line support who tend to do slightly a bit more of the programming, a bit more advanced on how they support the customers. You have a bit more knowledge on what you're sort of working on. And then you've got your third-line support where you're out there, you're sort of doing all the mainstream planning, you're doing all the mainstream engineering…. (Apprentice 2, Networking SME)

Importantly, it was suggested that apprentices with prior knowledge of IT, regardless of whether or not they hold relevant qualifications, may be recruited to roles higher than entry level, as exemplified by the apprentices at the Networking SME:

I didn't start up as a first-line, I kind of got thrown straight out there. I went to site, meeting clients face to face on my first day. So I'm kind of classed as like second-line, third-line. (Apprentice 1, Networking SME)

3.6.5 Apprentices' perceptions of programmes

Overall, apprentices were satisfied with the learning associated with their workplace and believed that their knowledge had expanded considerably through their apprenticeships. They felt that the apprenticeships were preparing them well for their chosen careers in specific areas, such as network engineer or software developer.

Importantly, all apprentices preferred the workplace element over the college classroom, echoing previous research on apprenticeship (e.g. Brockmann, 2012). Apprentices valued learning at work and benefited from the 'hands on' and practical aspects of their learning.

> … the workplace obviously teaches me a lot more. I … actually learn how things work by seeing how they work. Things that are new to me like all the servers, how they're all set up, you know. Because we had a server crash and so we had to go through and actually reset all our internal servers, so I learnt a lot from that.… (Apprentice, Non-IT SME)

Similarly, the apprentices at the large IT employer valued learning on the job, and the mentoring system operated by the company:

> If I actually watch someone doing it and go through their process and how they've worked through the problem, especially like looking like system dumps which is just the memory of the computer on a green screen, right, if I'd just read a book about how to debug them and then went and did it I would not get anywhere. (Apprentice 1, Large employer)

> … we can pick our mentor or our … kind of buddies that we can go and shadow or ask for advice and stuff, and they would pretty much introduce us into the job or whatever and give us hints and tips and stuff like that. (Apprentice 2, Large employer)

By contrast, apprentices' experience of the college element of their apprenticeship was mixed. A programming apprentice at the Networking SME related that he had been apprehensive about the college element as he did not consider himself to be good at 'academic' learning. However, he did now value the college element because it was closely integrated with the workplace. The quote below also illustrates how apprenticeships may spark and strengthen interest in IT, including for young people without any prior knowledge (or interest), as was the case for this young person:

> when I first joined this company … I didn't see myself coming this far … I was never really book smart … I've always sort of been a practical kind of learner … but once you start walking in there, "Hold on, wait a minute, everything I'm doing at work is relating to this". So it became really practical, so it wasn't a way of me sort of learning where I just had to read things, it became a way of life in a way, where it was an everyday habit. You know, I'd just walk into the office, I'm programming a router, but I'm going to college late in the evening and I'm learning how to program a router. (Apprentice 2, Networking SME)

However, one apprentice felt that the units that he was studying at the college did not relate to his workplace:

Yeah, college I don't learn so much. A lot of it, to be honest, I already know … I don't know if there is much of a connection to be honest, it's just about getting the units done so obviously the workplace gives me units towards my course and the college gives me units towards my course so I think that's the only way they really interact. (Apprentice, Non-IT SME)

The experiences of another apprentice also suggest that the content of the college element may not always closely match the role in the workplace. Providers may not be able to accommodate the needs of employers and there can be a lack of consensus in agreeing the training content. The Level 3 apprentice at the Networking SME related a particularly negative experience with a private training provider:

… because it was phones, it was networking, it was web design, it was app design, you know, it was programming, coding … And it was all based on employer feedback going, "Okay, for his placement I need him to do this, this and this …" At the same time, like there was a lot of argument of … what employers wanted and what the tutors could teach and it was like, well they don't really need this, and all that stuff. (Apprentice 1, Networking SME)

In developing college-based education, it seems important to ensure not only the relevance of modules to the workplace but also to design them in a way so as to engage young people. One apprentice who had attended a full-time HNC at College A valued the practice-based element:

So the networking unit, we were basically given a scenario. So there's basically a new networking company and … they've got a set of requirements … So you had to write a report on how you're going to do it, then design a topology for it and then sort of configure it all so it's all working. And then sort of, test it and evaluate it … And it was quite a lot of work … it definitely tests your actual capability of actually doing it. (Apprentice, Non-IT large employer)

Apprentices recognised the value of softer skills. Communication skills, such as interacting with customers and professional writing, were deemed to be particularly valuable and relevant in the workplace.

I think a lot of people get carried away with the technical side of things and I think professional skills and personal skills such as presentations and how to communicate with people – I think that's really important …. just how to act in a professional environment. I think the communication one's a big one. Professional writing and things like that. (Apprentice 1, Large employer)

IT professionals do not just require hard technical skills; their jobs require them to liaise with clients, and good communication skills are a key part of their jobs. Any form of learning or training needs to incorporate development of soft skills, such as effective communications, professional writing and team working.

Because when I started, I was off to sites straight away…. "okay, so we'll go to this client then, they've been done for all day, you know, they're going to be really annoyed, they want to get it solved, you know", so we've had to like speak to a client, you know, empathise with them and be like, we understand that you're down and it's affecting your work. (Apprentice 1, Networking SME)

Specific advantages of pursuing apprenticeships at small and large companies surfaced during the interviews. Being an apprentice at Level 3 or 4 in a small company was advantageous because it facilitated more rounded learning. This was because the roles were broader, and being part of the small team also meant that apprentices were more noticed since they were 'one of few rather than being one of many'. On the other hand, the merits of doing an apprenticeship at a large company included the availability of more resources and possible rotation of tasks which facilitated switching and trialling newer areas and a greater diversity of roles.

Young people at the large employers in our sample valued the opportunity of getting to know different parts of the company. The apprentice at the large non-IT company explained that his employer encouraged apprentices to try different placements to help them understand their strengths and interests:

> … there was a placement I was in and I was just like, "It's not for me". I just wasn't enjoying it at all and I didn't feel like I was being challenged enough, and things like that. I told my manager and … she … changed my placement within two weeks. Which I thought was good, I really wasn't happy and yeah, they sorted me out. (Apprentice, Non-IT large employer)

Apprentices at the large IT firm also valued the rotation of roles:

> We can rotate roles within the apprenticeship, so you can be doing something for six months and then say, "Oh, I want to try this". (Apprentice 1, Large employer)

> I suppose that's a good thing because if you didn't get matched to the right job at the beginning you can always kind of change throughout the three years. (Apprentice 2, Large employer)

Also, being part of a large firm seemed to enable apprentices to undertake wider training and certifications that a smaller employer is unlikely to support.

3.6.6 Vendor qualifications

All apprentices highlighted the relevance of vendor qualifications, particularly for career progression. Both apprentices at the Networking SME saw vendor qualifications as more useful for their future progression to more specialist roles than standard provision. Thus, the Level 3 apprentice intended to obtain certification from a leading telecommunications company, rather than pursuing a Level 4 apprenticeship.

> Avaya's just like a sort of telecommunications company. So obviously they've got their own sort of courses, their own sort of set of engineers, and that's the sort of line I sort of steered more into … and you need about a year's experience before you can start applying for any [vendor] qualifications. So it's coming up to about a year's experience now and I'm steering into going to get my first junior qualifications to accredit myself as an Avaya engineer. I will be on the first level, which will be ACIS, and then you move onto a more senior level which will be ACSS. (Apprentice 2, Networking SME)

Similarly, his fellow apprentice at the company argued that while his Level 4 apprenticeship provided him a strong foundation, he did not wish to study for an HND (Level 5 apprenticeship). He believed that vendor qualifications were more relevant and recognised:

Once Level 4's done, I want to be going to vendor quals, so Cisco, CCNA, which is basically the industry standard for basic networking … because Cisco are the industry leaders of networking, and they provide their own qualifications. My company also deals with Juniper, which is like a competition of Cisco and they do their own qualifications. So I want to be doing them as well. (Apprentice 1, Networking SME)

Interestingly, regardless of their specialism (networking or software development), most apprentices in our sample indicated that they wanted to achieve vendor certifications offered by Cisco (i.e. CCNA or CCNP). This was because general technical support was seen to be valuable for fulfilling any role in IT, and was therefore seen as a transferable skill. For example, the apprentice at the non-IT SME aimed to become a software developer, but he believed he could still benefit from Cisco certifications. While he wanted to become a software developer, he had responsibilities for networking, and he could pursue networking as an alternative route for his future:

… there will probably be additional programming vendor qualifications and maybe I might pursue the Cisco a little bit more because I still do enjoy the networking side of things.… I want to get into programming preferably. Networking's kind of a second resort.… I ideally want to be doing stuff like development … and also considered being self-employed and making my own company selling things, I'm kind of doing a bit of that on the side already, like doing my own project. (Apprentice, Non-IT SME)

SECTION 4 CONCLUSIONS

Our findings would suggest that efforts towards establishing the IT technician as a desirable occupation or status have some way to go. However, one important issue here is with the term 'technician', which is widely associated with low-level IT support tasks. This view was shared by almost all participants in our study, including employers and providers.

Our study was guided by the definition of technician (underlying the BCS Registered Technician Standard) as someone who applies their knowledge and skills in order to solve technical problems. Consequently, we found that technicians work in a large variety of roles, across all IT areas and levels of the organisation. The roles may include elements of strategic and managerial responsibility, notably at the higher levels.

The identification of job titles in IT organisations proved challenging, partly because of trying to avoid the term 'technician' and partly because of their fluidity. As a result of rapidly advancing technology, job descriptions may change quickly or are broad enough to encompass a range of activities. The IT support function, in particular, is commonly subsumed under a broader role. It is typically assigned to new job entrants such as apprentices and graduates, and serves as a way of inducting them into the organisation.

One of the most important findings of this study is the *breadth of roles held by IT technicians.* This is particularly the case at SMEs, where staff are required to stand in for one another, and therefore need to have an understanding of the different areas of the business (e.g. programming, networking and IT support). While roles in large employers are typically more clearly defined, the client-driven nature of the work may mean that technicians need to have the breadth of knowledge required for an increasing range of products and services.

It is therefore important to note that all employers in our sample (SMEs and large) preferred technicians to have a *wide breadth of knowledge and skills* that went beyond any particular role. However, they had little confidence in standard qualifications obtained through full-time education. The knowledge and skills thus acquired were deemed out-of-date and not in line with specific employer needs. Instead, employers preferred to train job entrants according to their own requirements, which included developing much-valued business and interpersonal skills.

Equally, it is clear that IT educational provision under the current system tends to lag behind technology. A way forward here may be to include vendor qualifications in standard courses. Vendor qualifications are highly valued by employers, as they provide up-to-date knowledge on specialist products and are commonly obtained through CPD.

All employers valued apprenticeship as a model of learning, allowing them to expose learners to a range of different areas, and ensuring they develop *an understanding of the business as a whole, and their role in particular.* This approach also served as a way of identifying apprentices' strength and/or filling future skills gaps in the business. Many felt that broad exposure was crucial for allowing apprentices/learners to develop particular interests. The variety of learning experiences was equally valued by apprentices. The new apprenticeship standards were criticised by employers for being too specialised and narrow.

It is notable that apprentices were expected to become full members of the team from the start, working with *high levels of responsibility and autonomy,* particularly at SMEs. They commonly started in more generalist positions (e.g. in a support function, or being rotated to different areas) and were expected to specialise during or on completion of the apprenticeship. All employers in the sample were supportive of their apprentices' progression to higher educational levels (which is where the strongest demand is). Roles in SMEs in particular involved a high level of specialisation.

Our findings would suggest the need for IT routes (such as the new technical digital route) to provide a broad knowledge and skills base, while at the same time providing options to specialise, particularly at the higher levels. A broad base is important to enable learners to develop interests in particular areas. Crucially, most employers in our study (all SMEs) expected new job entrants (including apprentices) to have basic prior knowledge and 'demonstrable competence'. While some young people will be 'self-starters', having acquired skills in their spare time, for many more the experience will be different, not having had any experience prior to starting on an IT route (as illustrated by some of the apprentices in the study). The ability of, especially, full-time courses to engage young people in learning is critical here, notably through opportunities for applying knowledge in practice. College A in our study provides an example of best practice, by including work placements and simulated practice in workshops as part of their full-time Level 3 BTEC.

Employers clearly valued a community of practice model (Lave and Wenger, 1991), preferring to induct newcomers into the particular practices and processes of their organisation. They were generally dismissive of knowledge obtained through full-time education, while valuing the apprenticeship to the extent that it could be tailored to their particular demands. Lave and Wenger (1991) have been criticised for their focus on situated learning while neglecting formal learning and education (Fuller and Unwin, 1998), pointing to the importance of a knowledge base that enables learners to criticise established practice. Clearly, the IT industry, perhaps more than any other, heavily relies on the ability of the workforce to innovate. Our findings would suggest that this kind of theoretical knowledge – the underlying principles that do not become obsolete – and critical thinking which would allow innovation are only required at graduate level, hence the continuing demand for a 'mix of skills'.

However, it stands to reason that in order to ensure parity of esteem between the 'academic' and the 'technical' routes as proposed by the government (BIS and DfE, 2016), the latter will have to include a foundation of knowledge that has sufficient breadth and depth to secure equality of status. Similarly, the overriding concern with employer-defined skills and knowledge risks neglecting the needs and rights of the learner. Apprenticeships in England have been criticised for neglecting general education – an integral part of apprenticeship in other countries such as Germany – which would be critical in ensuring that young people receive the knowledge that enables them to become full members of society and to 'participate in society's conversation' (Wheelahan, 2008: 227). A strong knowledge base and general education on a par with A-levels are crucial for educational progression, as well as for job and occupational mobility.

Arguably, this level of general education would also develop learners' confidence and enhance their interpersonal skills. While all apprentices in the study worked with a high degree of autonomy and seemed to quickly progress to more advanced levels in the organisational hierarchy, this may not be the typical route

for the majority of young people entering full-time IT courses at Level 2. It is also important to note that many (particularly, large) employers require apprentices to have A-levels. There is a thus strong imperative to ensure that all young people have access to general education up to age 18.

While the research has highlighted a number of important themes, this was a small, exploratory study, and there is no claim that the findings are representative of IT technicians, employers and education providers generally. More research needs to be done particularly in order to improve the status of IT technicians, to address the IT skills shortage, and to inform the development of IT education routes.

While not a strong theme in our study, the concern with a severe IT skills shortage is ongoing (Macrae, 2016). Particularly problematic here is the lack of diversity within the IT workforce, with women being massively under-represented (The Tech Partnership, 2015), an issue that was raised by several of our study participants. Initiatives to address this have included attempts to improve the low and gendered take-up of IT subjects in schools. Schemes to encourage girls to take up IT have had limited success (Fuller et al., 2013), while the impact of the new computing curriculum in English schools introduced in September 2014 has yet to be evaluated.

In terms of gender, research suggests that popular presentations of 'proper' girlhood may be incompatible with the masculine image of certain occupations, including IT, while other studies point to work-related factors, such as the organisation of work and the 'male' culture of IT workplaces, which may deter women from taking up IT occupations (Castaño and Webster, 2011). Clearly, more research is needed here in relation to IT technicians, their work practices and organisations.

A similar concern must be to increase the participation of young people from lower socio-economic groups (The Princes Trust, 2014). Little is known about their teaching and learning preferences and their perception of IT. The development of IT routes that succeed in delivering creative and high-quality provision will be of prime concern.

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