APPRENTICESHIP AND THE CONCEPT OF OCCUPATION

ALISON FULLER AND LORNA UNWIN
INSTITUTE OF EDUCATION, LONDON

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EXECUTIVE SUMMARY

INTRODUCTION

This report presents findings from a study which examined the extent to which occupational identity underpins contemporary apprenticeships in England, and the implications for policy and practice of the decoupling of apprenticeship from the concept of occupation. The study focused on the STEM-related sectors of the economy, and addressed the following research questions:

- How is the concept of occupation and occupational identity defined and characterised in the research literature?
- How many government-supported Advanced and Higher Apprenticeship frameworks can be regarded as being STEM-related?
- To what extent are these STEM-related frameworks built around a concept of occupation?

The term 'apprenticeship' is often used colloquially by people from different backgrounds such as doctors, journalists, hairdressers and carpenters to refer to a model of work-based learning that has enabled them to develop the required levels of expertise they need in their occupation and to be accepted as a full member of an occupational community. Apprenticeship also refers to a formal arrangement between an apprentice and an employer. Apprenticeship was strongly aligned with the concept of (skilled) occupation in the United Kingdom (UK) until the introduction of the government-supported Modern Apprenticeship in 1994. At that point, apprenticeship became a 'wrapper' for a set of mandatory outcomes (specified as qualifications in a sector-based 'framework' by government) rather than being seen as a programme of learning leading to a recognisable occupational identity with labour market currency. The Richard Review's proposal for the certification of performance in apprenticeship to be based on meeting an agreed standard (one qualification covering the whole apprenticeship) has the potential to reconnect apprenticeship with its occupational roots. As this report argues, however, to achieve Richard's vision will require a radical overhaul of current arrangements.

METHODOLOGY

Evidence for the study was collected via: a) a review of the research literature on occupation and occupational identity; b) an analysis of the National Apprenticeship Service's (NAS) 'library of apprenticeship frameworks' database to identify three STEM-related frameworks suitable for development as case studies; c) an analysis of the characteristics, content, pedagogical and assessment features of the case study apprenticeship frameworks; and d) a comparison of the descriptions of apprenticeships on the NAS website with the way they are described on the equivalent national website in Germany.

CONCLUSIONS

The study concludes that, whilst there are some high quality apprenticeships in England, particularly in fields related to engineering and technology, the 'anything goes' approach to the inclusion of job titles and job roles across and within frameworks has created a highly inconsistent and overly complex system. In relation to STEM, the fact that apprentices from level 2 to level 5 can be classed as a 'technician' shows that there is no shared understanding of this term and what it might signify in terms of the level of skills required in an occupational field. Where apprenticeship has been grafted on to an occupation with a strong history and culture, supported by institutional regulation and professional registration, it is more likely that there will still be a strong connection between occupational identity and apprenticeship. However, overall the picture is one of a weak relationship as apprenticeship is conceived first and foremost as a job. Developing holistic definitions of occupations would entail a shift in the conception of the government-supported apprenticeship programme, as well as triggering reforms to support the recognition of designated apprenticeship occupations in the labour market. The study argues that this approach would strengthen the quality of the programme and its ability to foster occupational identity. It would also make the strengths and benefits of apprenticeship more transparent for prospective apprentices, employers, parents, careers guidance staff and other stakeholders.

RECOMMENDATIONS

1. Each apprenticeship should be clearly related to one occupational title.
2. The current organisation of apprenticeship in terms of framework, pathway(s) and job roles should be replaced with one specification document per apprenticeship.
3. The detail of each apprenticeship should be provided in standardised format in a document written in clear language. Currently, some frameworks use equivocal terms such as 'an apprentice may be able to ...' and 'could find themselves…' in relation to what they may be doing on an apprenticeship and their occupational career progression options. The revised documents should be made available on the NAS website in a form that makes them easily accessible by the general public. This is vital for effective careers information, advice and guidance.
4. The use of the terms technician and technologist within the apprenticeship frameworks should be reviewed to bring them in line with the Technician Council's stipulation that they should only apply to level 3 and above.
5. The extent to which the frameworks involve the development of STEM-related skills and knowledge needs to be investigated. This includes analysis of curricula and qualifications and also the functional skills requirements.
6. In line with the Richard Review, each apprenticeship should lead to one qualification/form of certification. There are already qualifications that are recognised and have status in the labour market for entry to skilled employment and, where available, these should be used. This would ensure that every apprentice who completed their programme would know that they had met the requirements for entry to their chosen occupation and had acquired sufficient skills and knowledge to progress within and beyond their immediate job role.
7. To put apprenticeship on a much stronger footing will require government to seriously consider extending the use of mechanisms such as licence to practise and registration of technicians.

SECTION 1 INTRODUCTION

The term 'apprenticeship' is often used colloquially by people from different backgrounds to refer to a model of work-based learning that has enabled them to develop the required levels of expertise they need in their occupation This applies to doctors and journalists as well as to hairdressers and carpenters; they share the need to learn through practice over time so that they can refine their skills and knowledge to the point where they can work without supervision and be accepted as a full member of an occupational community. Apprenticeship also refers to a formal arrangement between an apprentice and an employer. Up until the late 19th century in many European countries, including the UK, apprenticeships were the responsibility of occupationally-based 'guilds' who used this model of learning to ensure they could both protect their trade and craft 'secrets' and continue to reproduce generation after generation of experts (see Fuller and Unwin 2010).

Historically, Apprenticeship was strongly aligned with the concept of (skilled) occupation in the United Kingdom (UK). In 1964, the Industrial Training Act established sector-based Industrial Training Boards (ITB) to encourage more employers to provide formal training. From that point, the state's involvement as both a funder and organiser of vocational education and training (VET) grew considerably. This has meant that the concept of 'sectors' has come to dominate the way VET is organised and has given rise to a succession of sectoral intermediary organisations (Keep 2006). In the late 1980s, the introduction of competence-based qualifications was underpinned by the concept of sectors in that they were derived from National Occupational Standards which were the responsibility of the sectoral bodies (Raggatt and Williams 1999). The concept of sector is used as a supply-side mechanism for the organisation of government-funded VET (see Jagger et al 2005), and hence, qualifications and apprenticeships are grouped in sectoral and sub-sectoral terms, rather than in occupational terms. With the introduction of the government-supported Modern Apprenticeship in 1994, apprenticeship became a 'wrapper' for a set of mandatory outcomes (specified as qualifications in a 'framework' by government), rather than being seen as a programme of learning leading to a recognisable occupational identity with labour market currency (Fuller and Unwin 2010). The Richard Review's (2012) proposal for the certification of performance in apprenticeship to be based on meeting an agreed standard (one qualification covering the whole apprenticeship) has the potential to reconnect apprenticeship with its occupational roots. As this report will show, however, to achieve Richard's vision will require a radical overhaul of current arrangements.

Whilst in some areas, the relationship of apprenticeship to occupations has continued due to the maintenance of a strong and long-standing apprenticeship culture (e.g. in areas of engineering and construction, hairdressing, and parts of hospitality), in others, the connection is underdeveloped and even non-existent (e.g. customer service, parts of retail, business administration, health and social care). This contrasts with the way apprenticeship is designated and conceptualised in some other European countries and North America, and to some extent in Australia.

In this report, we present the findings from a study which examined the extent to which occupational identity underpins contemporary apprenticeships in England[1]

1 The structure of government-supported apprenticeships in Scotland, Wales and Northern Ireland share many similarities with England, but there are differences. Whilst we would argue that the findings and discussion in this report are relevant to the whole of the UK, we acknowledge that the specific context for our research has been England.

and the implications for policy and practice of the decoupling of apprenticeship from the concept of occupation. Given that apprenticeship continues to be regarded as a major vehicle in the government's plans for economic recovery and growth, the study focused on the STEM-related sectors of the economy. The study addressed the following research questions:

- How is the concept of occupation and occupational identity defined and characterised in the research literature?
- How many government-supported Advanced and Higher Apprenticeship frameworks can be regarded as being STEM-related?
- To what extent are these STEM-related frameworks built around a concept of occupation?

SECTION 2 METHODOLOGY

In order to address the research questions, we adopted a mixed-method approach for the research involving the following stages:

- A literature review to identify the ways in which occupation and occupational identity are conceptualised and characterised in the research literature in order to create a framework for analysis (see Section 3).
- An analysis of the National Apprenticeship Service's (NAS) 'library of apprenticeship frameworks' database to identify three STEM-related frameworks suitable for development as case studies (see Section 4).
- Desk research to analyse the characteristics, content, pedagogical and assessment features of the three case study apprenticeship frameworks (see Section 5).

We also compared the descriptions of apprenticeships in England available on the NAS website with the way they are described on the equivalent national website in Germany.

SECTION 3 CONCEPTUALISING OCCUPATION AND OCCUPATIONAL IDENTITY

The concept of 'occupation' is rooted in and continues to reflect the cultural and historical norms of each country. Occupational categories arise from a 'division of labour' and are used by gatekeepers (e.g. professional bodies and education institutions) to regulate entry to the labour market and as the basis for designing VET programmes. They are also used in social research, the media and society at large as an indicator of social class (Crompton 2008). Dictionary definitions illustrate the elastic and overlapping nature of the way occupation and the related terms 'trade', 'craft' and 'job' are used in the UK[2]:

- Craft: "creative activity involving construction, carving, weaving, sewing etc... a skilled trade; the members of a trade collectively; an occupation; cunning; dexterity"
- Job: "any individual piece of work; any undertaking or employment done for payment or profit; an occupation or post; someone's proper business or responsibility; a task to be performed by an operating system"
- Occupation: "one's habitual employment, profession, craft or trade"
- Trade: "an occupation, way of livelihood, esp. skilled but not learned; shopkeeping, commerce, esp. as opposed to a profession; buying and selling; ...a craft, esp. requiring training; a practice."

On the apprenticeship section of its website[3], the ECITB uses a distinction between craft and technician apprentices (with the latter having higher status than the former) that has been common since the 1960s:

> *A Craft Apprentice will still be required to attain a level of underpinning knowledge to rest alongside these skills. The achievement of a further education qualification is a must. The qualification is likely to have a significant degree of hands-on, practical work to support the theory.*
>
> *Technician Apprentices will have a greater degree of input than Craft Apprentices in the design and development of systems, diagnosing faults and inconsistencies, identifying remedial actions to be taken and will generally be responsible for the smooth-running of systems and equipment. The recording of results on completion of test conducted will play an important role and communication with other team members is pivotal.*
>
> *A Technician Apprentice's educational training will be much more theory based and the Apprentice will be required to achieve at a higher level than a Craft Apprentice as a minimum. Clearly, a higher level of prior attainment at school or college is therefore a distinct advantage.*

The craft-technician hierarchy can still be detected in the way government-funded apprenticeships are described, but now the terms have been de-coupled from the connection to distinctive levels of education and training programmes. The term 'technician' is used very broadly in English apprenticeship frameworks both in terms of the spread of qualification and skill levels it is associated with and the range of

2 From The Chambers Dictionary, 2003

3 http://www.ecitb.org.uk/Programmes/Apprenticeships/Learner/WhatAreTheECITBApprenticeshipOptions/ (accessed July 3rd 2013)

sectors. A consequence of this slippage and absence of any state regulation to define and protect the title 'technician' is the inconsistent and ad hoc use of terminology.

Many young people over the years will have been advised by their parents to 'get a trade' as a means of ensuring regular and decently paid employment. In Canada, Australia and Ireland, there is still a strong distinction between what is seen as a 'proper' apprenticeship, by which is meant 'in the trades', and traineeships in the service industries. The Australian equivalent of the NAS website states that the country's apprenticeship programme covers 500 'occupations' including 65 'traditional trades' which are experiencing national skills shortages (see appendix 1).

A useful way to approach the meaning of occupation is to consider the term 'job' which, in the UK, is sometimes used interchangeably with occupation. Linda Clarke (2011:102) argues that the term 'job' has a much more limited meaning than occupation because it is connected to an employment contract in a workplace, hence, a job description lists the tasks an individual is required to perform. In contrast, an 'occupation' is a 'much more general and all-encompassing term for employment' in which individuals are engaged and is not restricted to a workplace. Clarke's conceptualisation of occupation is aligned with the German concept of *Beruf* which, as Walter Heinz (1999:8) explains, is equated to the idea of vocation and 'carries the image of an occupation for life that applies to all ranks in the hierarchy of occupations, from crafts to professions'. Heinz locates the concept of 'career' within the meaning of *Beruf*, hence, career indicates 'an individual's journey through different jobs and statuses' (ibid). Career is 'associated with the notion of upward mobility', but also with 'horizontal and downward movements in the occupational structure' (ibid). He adds:

> *Empirically, careers are driven by social origin and gender, mediated by education, shaped by specific occupations and labour-market process, and are activated by individual decisions and institutional gatekeeping. (ibid)*

Given the highly gendered nature of apprenticeship in many countries, including the UK, Heinz reminds us that whilst it is possible to see the concept of occupation as a neutral one, the way in which individuals gain access to and progress within occupations is still affected by class, race and gender (see also Crompton 2008).

In his classic text on the 'labour process under capitalism', Harry Braverman (1974:109) argues that up until Frederick Winslow Taylor developed his scientific management techniques in the late 19th century, 'the craft or skilled trade was the basic unit, the elementary cell of the labour process.' He continues:

> *In each craft, the worker was presumed to be the master of a body of traditional knowledge, and methods and procedures were left to his or her discretion...in view of the knowledge to be assimilated, the dexterities to be gained, and the fact that the craftsman, like the professional, was required to master a speciality and become the best judge of the manner of its application to specific production problems, the years of apprenticeship were generally needed and were employed in a learning process that extended well into the journeyman decades. (ibid)*

For Braverman, occupations became deskilled or, in the case of crafts, wiped out as a result of Taylor's efficiency revolution and the removal of the opportunity for workers to conceptualise their work tasks. Similarly, in his book, The Craftsman, Richard Sennett (2008:20) has argued that 'all craftsmanship is founded on a skill developed to a high degree'. For Sennett, craft is essentially a creative process involving the making of something (e.g. a piece of furniture or a performance of music), and it is through making things (a 'vigorous cultural materialism') that people learn about themselves: 'Craftsmanship names an enduring, basic human impulse, the desire to do a job well for its own sake'(ibid:9). Like Braverman, Sennett is concerned that contemporary forms of labour process severely restrict opportunities for people to develop and deploy their craft. This has echoes with the ideas of Joseph Bensman and Robert Lilienfield (1991, originally published 1973) who, in their attempt to develop a new approach to the sociology of knowledge, argued that people's 'habits of mind' and 'attitudes towards everyday life' emerged and were developed through the practice of an occupation, profession or craft:

> *While one can argue, with Marx, that one's social experience determines one's consciousness, a major component of that social experience is the specific things one does in one's occupational and professional practice. This includes the peculiar quality of the social relations involved in the practice... it includes the nature of the materials with which an occupation works... Occupation as craft creates, for any particular occupation, an attitude which is unique.*

The concept of occupation, as used in the extract above and in relation to the German concept of *Beruf*, is central to the development of identity. The anthropologists, Jean Lave and Etienne Wenger (1991) in their seminal text on apprenticeship argue that learning, in what they first termed 'communities of practice', is a socially situated process. An individual such as an apprentice who is a newcomer to the occupational community is defined by as well as playing a role in defining those relations:

> *Learning thus implies becoming a different person with respect to the possibilities enabled by these systems of relations. To ignore this aspect of learning is to overlook the fact that learning involves the construction of identities... identity, knowing and social membership entail one another... (Lave and Wenger, 1991:53)*

Occupational identity is not seen as a static concept, but one that is dynamic and multi-faceted (a continuous process) and a dimension of the broader concept of identity itself. Individuals construct or shape their occupational identities within cultural contexts. Rudman and Dennhardt (2008), writing from the perspective of developments in the field of occupational therapy, discuss Kielhofner's (2002) notion of the narrative construction of occupational identity which provides a 'vision of life' (Kielhofner cited in Rudman and Dennhardt, 2008:155) whereby some individuals adopt the identity of those around them, whilst others exert more agency. To enact the vision requires the development of occupational competence (what Kielhofner calls a 'pattern of occupation').

The development of an occupational identity (the process of 'becoming') takes time and commitment and, hence, the process of maturation has always been seen as central to apprenticeship. In his discussion of the development of occupational self-concept and commitment to an occupation by apprentices in printing, R.A. Flude (1977) applied two concepts developed by sociologists studying professionals in the 1960s. The first concept was developed by P.W. Musgrave (1967): 'anticipatory socialisation' – as an individual progresses through their training, they become more likely to identify themselves as a full member of their occupational group. The second concept, that of commitment to an occupation, was developed by Howard Becker (1960): the investment of time and self-esteem in training means that an individual may feel they have to commit to the occupation because otherwise they will waste their investment. Flude (1977:42) argues:

> *My general hypothesis is that apprentices in the printing trades are entering into the same kind of relationship with their job as, for example, music or medical students. They accept a subordinate role to prepare for the full role. They accept low financial returns for some years in the expectation that will reap a reward. They desire security and skilled status and they are concerned with the future and not simply the immediate rewards and satisfactions of their work.*

Flude's work showed that the apprentices in his study were not simply training for a job role, but to become full members of an occupation. However, as Braverman's analysis highlighted, the changing nature of production and work organisation associated with industrial and technological innovation undermined the demand for and availability of traditional occupations and skilled trades. This had affected opportunities for the kind of lengthy skill formation and training processes that formed the foundation of occupational identity. By the 1990s writers such as Robert Reich[4] (1991) and Catherine Casey (1995) were conceiving advanced industrial liberal economies such as the UK and the US as 'post-occupational' (Fuller 1999). The implications for occupational identity stemming from the economic, technological and industrial changes of the second half of the twentieth century were significant. Expectations for many individuals were shifting away from the notion of life-long employment and strong occupational identity to a recognition either that it would be necessary to move between jobs as occupational skills became obsolete, or that the range of activity required from specialist roles would alter. In response to such trends Reich (1991) argued that a radical re-categorisation of work was needed, which did not depend on defined occupations as its basis.

Building on his analysis of the US economy, Reich proposed that in the competitive sector of the labour market three over-arching work roles were emerging. They were 'routine production services', 'in-person services' and 'symbolic-analytic services' which offered broad concepts of work activity that were decoupled from the notion of specific occupation. Routine production services referred to jobs in mass production enterprises, whilst in-person services referred to routine interpersonal or customer-facing roles. The final category (symbolic analytic services) referred to 'problem-solving, problem identifying, and strategic brokering activities' and as including all those who 'solve, identify and broker problems by manipulating symbols.' According to Reich it was only the last, the symbolic analysts, comprising about 20 per cent of the American workforce (in 1990), which he saw as having an increasingly strong position in contemporary international labour markets based on their ability to add value to an enterprise through the creative use of knowledge, skills and experience. In contrast with the past when the division of labour had been based on demarcated skills, training, and strong occupational identities and loyalties, increasing this part of the workforce would require the expansion of higher education as the platform for creating the 'symbolic analyst' workforce who could enable countries like the US to compete in the new order of the knowledge economy.

From the perspective of 2013, claims from twenty or so years ago about the advent of a post-occupational era can be seen as premature, although the strength of the concept of occupation in different kinds of labour market varies. Hence, in countries such as Germany the notion and relevance of *Beruf* continues to underpin its vocational education, training and apprenticeship system and to be supported through labour market regulation. In the German context the

4 Robert Reich was Secretary of Labor under President Bill Clinton from 1993 to 1997.

development of occupational identity is reinforced through statutory underpinning of apprenticeship training ordinances as well as by the legal definition and protection of the recognised *Beruf*. It follows that the regulated approach promotes a commitment to the occupation as distinct from (although it can be in addition to) the commitment an individual may feel to their employing organisation (Cohen 2007).

In contrast, institutional supports for the development of occupational identity and commitment are less strong in countries such as the UK which have more flexible labour market arrangements, and where people are increasingly expected to change jobs or occupational field throughout their working lives. Nonetheless, there continue to be parts of the UK labour market that are regulated and that have all the characteristics of occupations likely to foster strong occupational identity. For example, the role of dental technician is a statutorily regulated occupation with protected title and prescribed education and training pathways to entry which is seen to inculcate strong occupational commitment (Fuller et al 2012).

There is a lively debate in the UK about the advantages and disadvantages of occupational regulation, and the role of registration in promoting technician level roles in STEM occupations. A programme of work undertaken by the UKCES (Forth et al 2011, Tamkin et al 2013) has identified a range of criteria that characterise different kinds of regulation, including whether the regulation is mandatory or voluntary, affects the whole of an occupation or just parts of it, relates to education and training requirements, and so on. Four forms of regulation (Licensing, Certification, Accreditation and Registration) have been identified and associated with different implications for leveraging employers' commitment to education and training, and support for skills.

Central to debates about the role and consequences of occupational regulation is the way that occupations are defined and classified at the national and international level, including the SOC system in the UK, the international standard classification of occupations ISCO, and O*NET in the US. Two main concepts usually underpin such classifications – the nature and type of work being undertaken and skills, which are analysed in terms of degree of skill specialisation and level. The process of classification allows sets of work tasks (which may make up a particular job description) to be clustered with similar work activities to form larger sub-groups, which can then be aggregated into major occupational groups. A recent report focusing on skill classification by Cedefop (2013) states:

> *A job… represents a basic unit covering a certain set of work activities performed by one working person. Strictly taken, each job has a specific slightly different OSP [occupational skill profile]. Nevertheless, there exist jobs with very or quite similar OSPs and negligible differences. Those jobs then make up individual occupation… Classifications of occupations are thus a means of grouping jobs by their similarity. (p.15)*

The US classificatory system O*NET is updated annually enabling changes in the characteristics of occupations to be monitored. Six domains are used to describe the character of occupations; three focus on the characteristics of workers and three on the characteristics of jobs as shown in figure 1.

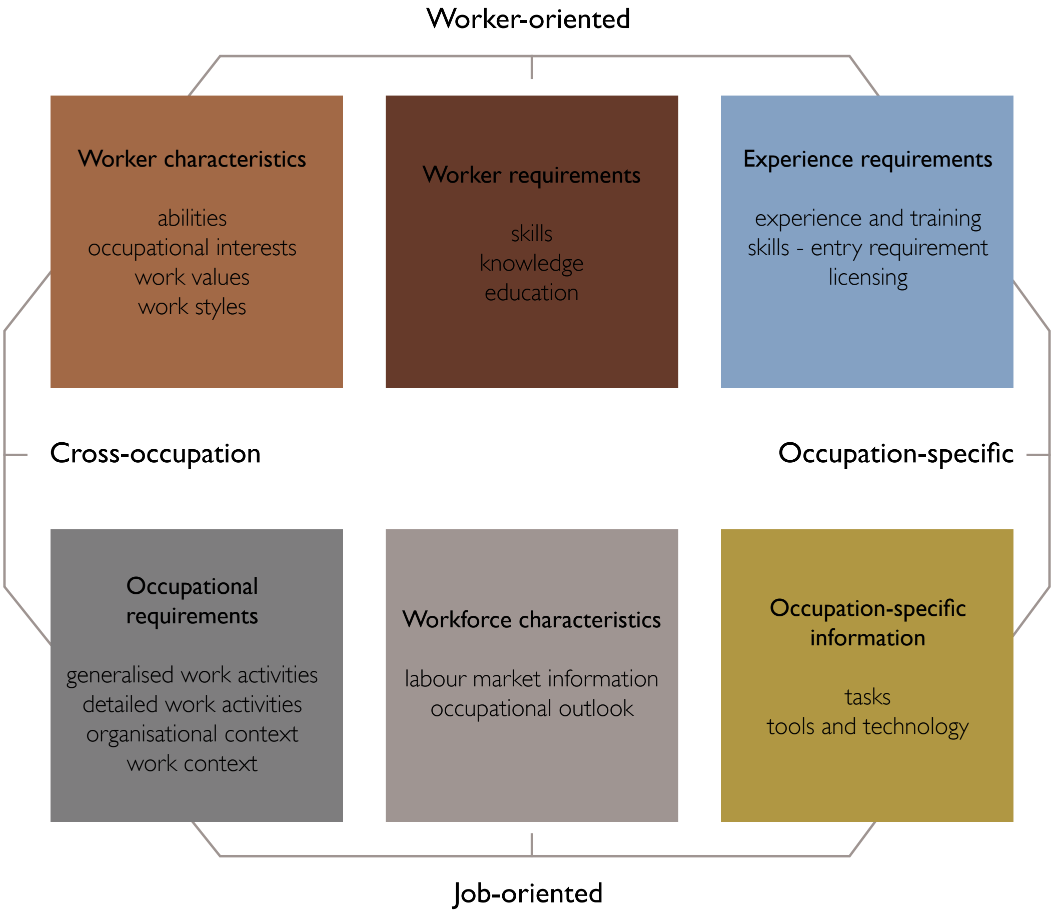

Figure 1: The O*NET content model (Source: O*NET Resource Center, http://www.onetcenter.org/content.html [accessed 13.11.2012]. Prepared by the National Center for O*NET development for the US Department of Labor.) This version of the diagram is adapted from the original.

In a study commissioned by UKCES to construct a systematic 'mapping' between the occupational classification used in O*NET and the UK Standard Occupational Classification (SOC), Dickerson et al (2012:8) state that the two most commonly employed measures of skills in the UK are:

> *(i) the qualifications that individuals have previously acquired; and (ii) the occupational classification of the jobs that they do. These both have the considerable virtue of being relatively simple to measure, but are poor proxies for the actual skills required by employers and used by individuals. Indeed, when asked about skills and skills needs, employers tend to focus on aspects of individuals and jobs other than their qualifications or occupations. These other aspects have been variously termed generic, key or core skills and attributes. Examples include communication, problem solving, numeracy and literacy skills.*

The authors argue that:

> *Until we have a much better understanding of the skills that are in relative shortage (or excess demand) and surplus (excess supply), then it will not be possible to really make significant progress in closing the gaps and addressing the mismatch between the skills that individuals possess and those that they require in employment in the UK labour market today. (ibid: 74)*

This fine-grained analysis of the skill profiles of occupational categories is clearly valuable for the reasons outlined in the above quotation. The breaking down of job roles into individual 'skills' (competences) underpinned the development of competence-based qualifications in the late 1980s and was seen, at that time, as a more systematic means for employers to carry out skills audits of their workforce and hence, to identify who needed further training (Unwin et al 2004). We would argue, however, that the UK approach to apprenticeship (and workforce development more broadly) is mired in lists of skills and job-related activities which have become detached from a concept of occupation. This detachment makes it harder for apprentices to construct meaningful occupational identities and, therefore, to have a vision of what they are trying to 'become'.

We began this report by stating that apprenticeship is a model of learning for skill formation which takes the apprentice on a journey to becoming a full member of an occupational community. This assumes: a) that there is a defined occupational community to join; and b) that apprenticeship is a recognised and formalised route to achieving the relevant occupational expertise required to join the community. What follows from this is that each occupation has a defined knowledge-base and associated curriculum which has to be completed and examined in order for the apprentice to show that they meet the requirements to practise as a recognised member of the community. As a result, the apprentice has at the outset a clear sense of the occupation they are aiming for and that if they meet the requirements they will gain the necessary certification for employment in that occupation. As we will show below, the government-supported apprenticeship programme in England is not underpinned by a strong conception of occupation and so does not guarantee for all apprentices who complete their programme that there will be a straightforward transition into recognised occupations. This is because the English system is underpinned by the perceived needs of a highly flexible labour market in which typically people can be easily switched between job roles within very broadly defined sectoral categories. As we noted earlier, some English apprenticeships are more strongly occupationally-based, but as we will go on to show even in these cases the occupational dimension is not always clear in the framework descriptions.

SECTION 4 ANALYSING THE GOVERNMENT-SUPPORTED APPRENTICESHIP FRAMEWORKS

There are only four references to the term 'occupation' on the National Apprenticeship Service (NAS) website. Three of these refer to the purpose of the 'apprenticeship agreement' (between the apprentice and their employer and training provider) to 'identify the skill, trade or occupation' for which the apprentice is being trained, whilst the fourth refers to 'a limited number of skills, trades and occupations' that are exempt from inclusion in the government-supported programme. NAS describes apprenticeships in the following terms:

> *They are work-based training programmes designed around the needs of employers, which lead to national recognised qualifications. You can use Apprenticeships to train both new and existing employees who are moving into a new or changed job role and need to learn new skills... Depending on the sector and job role an Apprenticeship can take anything between one and four years to complete. It is a package of on-the-job training and qualifications.*

There are around 170 live apprenticeship frameworks in England covering around 1,500 job titles and job roles (at levels 2 to 5). Each apprenticeship is linked to a specific job role and that means an individual can complete more than one 'apprenticeship' in the same occupational field. For example, someone wanting to become a chef is likely to complete an apprenticeship at level 2 enabling them to perform a semi-skilled job role (e.g. 'chef' or 'kitchen assistant') and then continue their training by starting and then completing a level 3 apprenticeship with a different job role (e.g. 'sous chef' or 'senior chef'). The government's apprenticeship participation statistics, therefore, count 'apprenticeships' rather than individuals.[5]

Apprenticeship is conceived as a job and, therefore, associated with the needs of an employer; hence, the primary identity is with the job and the employer, rather than with an occupation or occupational community. The primary focus in relation to the apprentice's commitment in this model is the organisation (job/employer) rather than the occupation. The concept of occupation ranges from highly limited (e.g. proven ability and low exchange value qualifications in a customer service role – allied to the needs of an internal labour market) to a much more rounded concept (e.g. advanced engineering apprenticeship leading to high exchange value, portable qualifications, and a foot on the occupational/professional registration ladder). The status and reputation of the employer in this case is highly significant, as the employer is strongly situated in the occupational community and so contributes to the generation of a strong combined organisational and occupational identity.

5 "...numbers are a count of the number of starts at any point during the year. Learners starting more than one Apprenticeship will appear more than once." (The Data Service) http://www.thedataservice.org.uk/Statistics/fe_data_library/Apprenticeships/

In England, each apprenticeship framework is designated by:

- a unique number
- a framework name
- an issuing authority (SSC)
- a level(s)
- its pathways and their corresponding 'job titles' and 'job roles'

In a glossary of terms on its website, NAS defines 'pathway' as 'an occupational area', as follows:

PATHWAY

An occupational area. Some frameworks are presented using one pathway and others contain multiple pathways. The pathway approach is used where there are one or more closely related occupations which do not justify a separate framework. Individual pathways must be SASE/SASW[6] compliant.

There is no entry in the glossary for 'occupation', 'occupational area' or 'job'.

If you were an individual interested, say, in becoming a gardener and seeking information from the NAS website about an appropriate apprenticeship, you would have to navigate a number of steps as follows:

Step 1 – a tab titled 'Types of Apprenticeships'

Step 2 – a choice of ten sectoral categories including Agriculture, Horticulture and Animal Care

Step 3 – a choice of twelve 'industries' including 'horticulture'

Step 4 – general information plus a list of job titles for Intermediate and Advanced Apprenticeship Gardener is listed under Intermediate, and Senior Gardener and Gardener (Historic and Botanic) Parks Officer are listed under Advanced.

Step 5 – choice of tabs: 'vacancies', 'benefits', 'framework library'

Step 6 – choose 'vacancies', asked for a 'keyword' (e.g. put in gardener), and to select a location from a drop-down list (e.g. Derbyshire) or put in a postcode

Step 7 – list of random vacancies with specific employers and associated training providers appears including, for example, 'garden room café assistant', 'garden centre sales assistant', 'horse care', and 'sheet metal worker' with a firm called 'Gardner Aerospace'.

Step 8 – to proceed, you have to register as a user on the site.

The alternative way to use the website is to click on the 'apprentices' tab which takes you to a 'vacancies' page (Step 6 above). Other than following quite a complex procedure to gain information, it is not possible to find out how to become a gardener. As we will show in Section 5, this is in stark contrast to the German website which opens straight to an alphabetical list of occupations of which gardener is one.

6 Specification of Apprenticeship Standards in England (SASE); Specification of Apprenticeship Standards in Wales (SASW)

STEM FRAMEWORKS

To identify the number of STEM apprenticeship frameworks we extracted all those frameworks (forty-two) that include the terms technician and/or technologist in the job roles (see Appendix 2 for full list compiled at the time of writing). It could be assumed that frameworks that use these terms cover work of a technical nature. As a further check we looked at the framework titles. It is reasonable to assume that they do all cover work of a technical nature. Some of the forty-two frameworks use the term technician or technologist at more than one level; the range of levels is 2 to 5. Of the forty-two frameworks, seventeen include a level 2 apprenticeship that uses the term technician. This raises two issues. First, as we noted earlier in the report, the term technician is being used in an ad hoc fashion and at a level below that associated with technician level in other countries, and historically in the UK. Second, if we assume that frameworks that use the term technician are STEM-related then we have to look closely at the extent to which the content of the apprenticeship at level 2 has a STEM knowledge-base. For example, the Food and Drink Framework and Vehicle Fitting Framework at level 2 only require apprentices to achieve level 1 functional skills in Mathematics and have no mandatory requirement for ICT. This means that the knowledge component of the framework has to be relied on to provide the STEM content, and information about this is not available in the framework document. Excavating the STEM content of the knowledge-based component of a framework requires opening up the awarding body website to search for the qualification specification. Even then it is not clear what level of STEM-related knowledge and understanding is actually required.

In some frameworks at level 3 there is no mandatory requirement for any ICT. The explanation provided in the frameworks is usually that employers have said there is no requirement for ICT in their industry. In the case of the Fashion and Textiles level 3 framework, there is an additional comment that 'where ICT skills could be required in some job roles this would be around specific sector CAD/CAM vendor endorsed software packages, where training will be bespoke to both company and employee requirements in a sector setting and not a traditional ICT environment.' The question needs to be asked why all apprentices undergoing technical apprenticeships do not have the opportunity to acquire expertise in how to use industry-standard software packages.

As we have argued elsewhere (Fuller et al 2012), the definition of technician covers the content of the work being undertaken and signals the level of expertise and position in an occupational hierarchy (see also Technician Council). Our analysis of frameworks indicates that some do not appear to pass either test. Beyond the forty-two frameworks that use the term technician or technologist in their list of job roles, there are others that it could be assumed also involve work of a technical nature. A review of the titles of the (current) approximately 170 frameworks indicates that the majority fall into the broad technical category. An interesting anomaly is the case of the 'electrotechnical' framework. This apprenticeship framework is only available at level 3; it states that on completion an apprentice will have the skills, knowledge and qualifications to 'progress in their career with further training into job roles such as technician.' In this example, the term technician is reserved for job roles at level 4 and above.

It is not possible, however, to establish from the framework documents alone the extent to which their content is STEM-related and whether the level of the knowledge acquired would be at technician level. A search of the relevant awarding body websites provides some information on the content and character of the framework's qualification components, but it is limited. To achieve a rigorous analysis and categorization of the extent to which the frameworks are 'STEM-rich' requires a dedicated piece of work.

SECTION 5 CASE STUDIES

We selected three STEM-related apprenticeship areas to develop as case studies to explore the connection between apprenticeship and occupation: engineering manufacture; information technology; and laboratory technicians. For each case study, we have outlined the ways in which the components of the individual pathways are described according to their place within the framework. Further details about the range of qualifications, amount of associated Guided Learning Hours (GLH), and suggested time for on- and off-the-job training associated with the frameworks are provided in Appendix 3. We then contrast this with the way apprenticeships are described in Germany. In Germany, apprenticeships (categorised as 'training occupations') are regulated under the Vocational Training Act. The Federal Institute for Vocational Education and Training (BIBB) oversees the development of new training regulations covering the in-company part of the apprenticeship, whilst the Lander (federal states) are responsible for developing the curriculum for the off-the-job element. Each 'training occupation' (*Beruf*) is covered by a 'training ordinance' and listed on the BIBB's website[7].

The German model presents a holistic picture of each designated occupation and its characteristics. The key points are the stipulated length of the apprenticeship, the specification of where the training will take place – in both the training company and the vocational school ('dual system'), and an outline of the occupational field and occupational skills to be developed through the apprenticeship. There is no vertical or horizontal differentiation within each occupation. If you were an individual (or parent or teacher) looking for information on becoming an apprentice and the training involved, the BIBB website is very easy to use as the 'training occupations' are listed alphabetically. This is in sharp contrast to the NAS website as it takes three 'clicks' to get from the home page to the list of framework areas. It is only by downloading an actual framework that you would see the qualification requirements and some suggestive indication of the type of training involved, though, as the case studies will show, the level of detail varies considerably. We can also contrast the NAS approach with the much more transparent explanation of how to become a dental technician provided on the NHS Careers website.[8] Here, as in the BIBB descriptors, clear and specific details are provided of the nature of the occupation and the training requirements.

7 http://www.bibb.de/en/index.htm.

8 http://www.nhscareers.nhs.uk/explore-by-career/dental-team/careers-in-the-dental-team/dental-techniciandental-technologist/

CASE STUDY A ENGINEERING MANUFACTURE

We focused on two frameworks: Intermediate and Advanced Apprenticeship in Engineering Manufacture (England); and Higher Apprenticeship in Advanced Manufacturing Engineering (England) (see Appendix 3 for further details).

The Intermediate and Advanced framework covers a considerable range of occupational fields under the umbrella of engineering manufacture. It states:

> *There are a very significant range of job titles, roles and occupations within the scope of this framework at levels 2 and 3, but essentially they can be grouped into operator/semi-skilled and craft and technician activities within the various sub-sectors. Operator, semi-skilled and craft roles generally being more common within the mature sub-sectors, and technician roles pertaining to the leading edge sub-sectors.*

The framework has seven pathways representing specific industries – e.g. aerospace, marine, fabrication and welding, and materials (processing and finishing) at Intermediate level (operator and semi-skilled) and fourteen at Advanced. It states that the duration of the Intermediate apprenticeships is 'approximately 18 months', and 'approximately 42 months' for the Advanced. There is no definition of the concept of occupation, but in a section profiling the engineering sector in general, the framework states that the key 'sub-occupations' at each level are as follows:

- *The main sub-occupations within the craft category include metal working, production and maintenance fitters, welding trades, electricians and electrical fitters, metal machining setters and setter-operators and electrical and electronic engineers.*
- *The main sub-occupations within the technician category include engineering technicians, draughtspersons, laboratory technicians and electrical and electronics technicians.*

Each pathway lists a set of 'job roles' and their corresponding 'job titles' (e.g. 'aircraft maintenance fitter' and 'shipwright'). Each pathway also specifies the range of permitted qualifications, the number of qualification credits to be achieved, and the associated number of Guided Learning Hours (see Appendix 3), all of which differ between and within pathways.

The pathways claim to facilitate both internal progression with the apprentice's employer and to higher level qualifications, but the framework directs apprentices to a range of websites to work out for themselves how to navigate the next steps.

The Higher Apprenticeship framework has eleven pathways (e.g. aerospace; nuclear related technology; mechanical; and electrical/electronics. It describes this apprenticeship as follows:

> *The Higher Apprenticeship framework for Advanced Manufacturing Engineering at level 4 has been designed to provide the manufacturing and engineering sectors with high grade technicians and engineers who have practical skills, combined with a higher education qualification. This will facilitate progression to level 5/6 qualifications and enable them to work towards 'Incorporated Engineer' status. Higher Apprentices will undertake higher-level technical occupations in such sectors as aerospace, nuclear, mechanical, electrical /electronics, automotive, maintenance, wind generation, research and development, marine, space and rail engineering.*

The term 'high grade technicians' is used, but there is no explanation as to how this differs from the use of the term 'technician' in the advanced apprenticeship. However, in a different section of the framework, the following explanation is given:

*The main sub-occupations within the **higher-level** technical occupations are:*

- *Technicians: engineering technicians, draftsperson, laboratory technicians, electrical and electronics technicians and quality assurance technicians.*
- *Professionals: mechanical engineers, design and development engineers, production and process engineers and planning and quality control engineers.*
- *Managers: production, works and maintenance managers, research and development managers and quality assurance managers.*

It is noticeable that there are only three references to 'level 3' in the framework and each relates to qualification entry requirements. There is no discussion of how this framework articulates with the Intermediate/Advanced framework. The framework states that there are four potential ways to progress from this apprenticeship: a) to the Higher framework for Advanced Manufacturing at level 6; b) to employment as a senior technician in marine engineering in a variety of job roles; c) preparation towards professional registration as an Engineering Technician and progression to Incorporated Engineer registration; and d) to a range of honours degrees.

COMPARISON WITH GERMANY

There is a range of engineering-related occupations listed on the BIBB website, but the closest to the job roles listed in the English engineering manufacture framework are:

- *Aircraft electronics technician*
- *Aircraft mechanic*
- *Boatbuilder*
- *Electrical fitter*
- *Electronics technician*
- *Electronics technician for: aerospace; building and infrastructure systems; devices and systems; industrial engineering; motors and drive technology*
- *Industrial mechanic*
- *Machine and plant operator*
- *Materials tester*
- *Mechatronics fitter*
- *Microtechnologists*
- *Pattern Maker/Model Maker*

For the purposes of illustration here, we provide details of the Boatbuilder apprenticeship (see Appendix 4 for details of three of the other apprenticeships). For each apprenticeship, there is a succinct explanation of the occupation followed by the skills to be covered during training.

BOATBUILDER

DESIGNATION OF OCCUPATION: Boatbuilder (m/f)
Recognized by ordinance of June 26, 2000 (BGBl. I. 2000, p. 987)
http://www.bibb.de/en/ausbildungsprofil_1689.htm

DURATION OF TRAINEESHIP: 3.5 years
The venues for training are the company and part-time vocational school *(Berufsschule)*

FIELD OF ACTIVITY
Boatbuilders' work covers the building, rebuilding, conversion and repair of yachts and boats and the services customary in this branch of business. Boats include yacht and boat types of timber, plastic, steel and aluminium or a combination of these materials. They carry out their work for example in workshops, in factory halls, winter storage sheds, in the outdoor installations of shipyards. or in boat centres and water sports clubs.

OCCUPATIONAL SKILLS
Boatbuilders carry out their work independently on the basis of technical documents, and work orders on their own, in a team and in cooperation with other trades. They plan and coordinate their work, set up workplaces, and take measures for safety and health protection at work as well as for environmental protection. They inspect their work for fault-free construction, document it, carry out quality assurance measures and calculate the services provided. In connection with the activities listed below, boatbuilders operate and maintain equipment, machines and transport equipment and set up and dismantle scaffolding.

BOATBUILDERS:
- measure and check the measurement results, mark off workpieces and transfer dimensions and outlines,
- select equipment and machines and set them up,
- maintain equipment and machines,
- work and machine workpieces made of wood, plastic and metal,
- make separable and permanent connections,
- prepare fibre-reinforced plastics,
- make jigs and fixtures, templates, models and moulds,
- make hulls, decks and superstructures,
- make hatchways and install them,
- mount deck fittings,
- carry out internal finishing work,
- treat and coat surfaces,
- erect masts and spars,
- install technical systems and test their functioning,
- maintain and repair boats,
- transport and store boats,
- use environmental engineering techniques.

CASE STUDY B INFORMATION TECHNOLOGY

We focused on two frameworks: IT, Software, Web & Telecoms Professionals (England), and IT Application Specialist (England); (see also Appendix 3 for further details).

IT, SOFTWARE, WEB & TELECOMS PROFESSIONALS (ENGLAND)

The first framework is available at three levels, intermediate, advanced and higher. There is no clear concept of occupation specified. Instead the apprenticeship is built around a concept of 'pathway', associated with a list of jobs specified in terms of titles and roles. A 'short description' is provided in the framework document:

> *This Apprenticeship framework provides the skills, knowledge and competence required to become an IT, Software, Web or Telecoms Professional in a wide range of job roles such as: IT Technical Support, Software Developer, Web Developer, Database Administrator, Telecoms Engineer, and Network Planner.*

There is one framework pathway: 'Pathway 1 IT, Software, Web & Telecoms Professionals'. The minimum length of both the intermediate and advanced apprenticeships is 12 months and the 'expected' length of the higher apprenticeship is 18 months.

It is not clear where the listed job titles have come from. This raises questions: is it the case that the framework issuer, e-skills UK, has analysed the job market to identify these as in demand by employers and/or needed jobs in the economy? Are these jobs for which there are vacancies – skills shortages? Will a search for job vacancies against these job titles find advertisements that ask for the qualifications included in the framework? A quick Google search on the term 'database administrator' confirmed that adverts are asking for specific skills/experience mostly on Microsoft SQL Server rather than the qualifications available in the apprenticeships.[9] There are no obvious principles underlying the terminology of the job titles listed in the framework. For example, it is not clear why three of the Higher Apprenticeships job titles/job roles are called 'manager', and none include the title 'engineer'. For level 3 apprenticeships, two of the titles are: 'engineer'; for level 2 two of the titles are 'technician' and 'professional'. In other words, there does not appear to be any underlying principle connecting particular titles (e.g. engineer, technician, manager and professional) with particular apprenticeship levels. The allocation of job titles across the levels appears ad hoc.

The 'job-specific' professional/vendor qualifications (e.g. Microsoft, Cisco, Oracle, VM Ware or CompTIA) are not included as mandatory in the framework. They are 'extras' which the apprentice may or may not have access to or funding to do. The framework states that, 'Some apprentices may elect to continue their technical studies and embark upon job-specific professional/vendor qualifications' (p. 19). There is an irony here in that the government-supported apprenticeship programme is conceived and promoted as providing training for a real 'job/job-role' which suggests that 'job-specific-ness' is valued, yet when it comes to the vendor/professional qualifications they are not included as mandatory, apparently because they are 'job-specific'. The point here is that these qualifications are not job-specific, but they are recognised in the IT sector/labour market. Job adverts

9 see, for example: http://jobview.monster.co.uk/Database-Administrator-Job-Sheffield-Yorkshire-UK-121298945.aspx

specify the particular products/programmes/systems in which candidates should have experience.[10] There is no indication that completion of the framework confers eligibility for individuals to register with (the) relevant professional body.

Although the framework document states that progression to the next apprenticeship level is an option at the end of the apprenticeship, it is neither automatic nor a right. Indeed it is not clear how the framework levels actually articulate in practice.

IT APPLICATION SPECIALIST (ENGLAND)

The second IT-related framework is available at two levels, intermediate and advanced. A 'short description' is provided in the framework document:

> *This apprenticeship programme is designed for new entrants to roles in which they will be working with IT systems and software. The framework offers a wide range of optional units that the Apprentice can study to match their particular organisational and job role requirements. Available at levels 2 and 3, the framework is suitable for those whose main job role is to use IT applications in support of colleagues or customers in any sector or industry. This can include:*
>
> - *Providing support and assistance to colleagues to make effective use of available IT systems and software*
> - *Developing, testing and implementing solutions to improve workplace productivity through the use of IT*
> - *Using the advanced features of IT Application Software in the creation and amendment of many types of formatted information including documents, diagrams, spreadsheets and presentations*
> - *Maintaining simple websites, using the internet to find and exchange information, and using social media to disseminate information.*

There is one pathway: 'Pathway 1 IT Application Specialist'. The minimum length for both levels is 12 months. As with the other IT framework, progression to the next apprenticeship level is an option at the end of the apprenticeship. There is no mention in the framework of professional/ vendor qualifications such as those offered by Cisco and Microsoft.

COMPARISON WITH GERMANY

There are five German IT occupations listed on the BIBB website. For illustration purposes we focus on one of these (see Appendix 4 for another example and links to details of others).

10 (see, for example: http://www.jobserve.com/gb/en/it+telecommunications-sector-jobs-in-united-kingdom/

INFORMATION AND TELECOMMUNICATIONS SYSTEM SUPPORT SPECIALIST

DESIGNATION OF OCCUPATION: Information electronics technician
DURATION OF TRAINEESHIP: 3.5 years.

Almost one-third of the training period is devoted to one of two main emphases:

- Office system technology
- Equipment and system technology

The venues for training are company and vocational school (*Berufsschule*)

FIELD OF ACTIVITY

Information electronics technicians supply comprehensive service for information technology systems for private and commercial customers.

They plan information and communications systems to meet customer requirements. They install components, software, accessories and networks. They carry out customer-specific demands by adapting hardware and software. They advise and train users when introducing systems. They carry out maintenance work and eliminate faults.

Information electronics technicians look after sales tasks and are available to their customers for advice and consultation.

In the office systems technology emphasis mainly information systems in the office sector are designed, installed and maintained and application programmes are drawn up.

In the equipment and systems technology emphasis mainly equipment and systems for recording, transferring, distributing, storing, processing and transmitting images, sound and data are designed, installed and maintained.

OCCUPATIONAL SKILLS

Information electronics technicians:

- present information and communications products, offer services, advise customers in the selection of equipment and systems, conclude sales and service contracts, and co-operate in marketing measures
- analyse customer requirements, operations sequences and information flows
- design information systems taking into consideration the work organisation as well as operational considerations
- install information and communications systems, telecommunications installations including terminal devices, computer networks, the accompanying power supply and lighting and start them up
- install and configure applications software, programme applications and test the systems
- set up and install information and communications systems including accessories and furniture taking into consideration ergonomic and organisational points of view
- advise customers in relation to operational sequences, utilisation and administration of the systems, data security and data protection as well as ergonomics and working environment
- analyse errors in information and communications systems and maintain equipment and systems
- carry out service, including operating advise, looking after users, user training and administration of systems.

CASE STUDY C LABORATORY AND SCIENCE TECHNICIANS

We identified and focused on one framework: **Laboratory and Science Technicians (England).** Whilst the title of the framework suggests a broad occupational focus, the specifications outlined within the document indicate a segmented approach to creating job-related apprenticeships. The framework is available at intermediate and advanced levels with the apprenticeship specified in terms of 'pathways' and also job titles, each of which is linked to a short statement of job role (see also Appendix 3 for further details). The 'short description' included in the framework states:

> *Laboratory and science technicians cover a broad range of occupational roles from those who support scientists and engineers in research and development work to those who provide quality assurance or analytical science services. They can also be found in schools, colleges and universities supporting teachers of science and technical learning. This framework is based on a previous framework for Laboratory Technicians jointly issued by Cogent and SEMTA. It is designed for laboratory and science technicians who carry out routine laboratory and science based operations and those involved in non-routine, more varied work activities such as planning, organising and leading technician support functions to assist scientists, educationalists and technologists in their work.*

There are four pathways available at intermediate level and three at advanced. The suggested length for the intermediate pathways is 18 months and 24 months for the advanced. There is no indication that completion of any of the apprenticeship pathways at either level 2 or level 3 confers eligibility for individuals to register with (the) relevant professional body. Progression from intermediate to advanced is an option.

COMPARISON WITH GERMANY

A search of the BIBB occupations website using the term 'laboratory' revealed the availability of six apprenticeship occupations. Three are located within a specific scientific discipline and three are located with a specified vocational or sectoral field. To illustrate we have included the specification for one of the scientific discipline based occupations, the Physics laboratory technician (see Appendix 4 for details of the Lacquer and varnish laboratory technician, an example of one located in a specified vocational field).

PHYSICS LABORATORY TECHNICIAN

DESIGNATION OF OCCUPATION: Physics laboratory technician (m/f)
DURATION OF TRAINEESHIP: 3.5 years

FIELD OF ACTIVITY

Physics laboratory technicians work in close collaboration with scientists in laboratories, in test facilities (in which processes are carried out on a larger scale than in laboratories) and in industrial production. In the production sector they are engaged primarily in quality control. In the areas of research, development, analysis, application technology and environmental protection they work independently, carrying out tests and measurements, evaluating them and recording the results.

OCCUPATIONAL SKILLS

Physics laboratory technicians:

- prepare measurements and series of tests;
- select appropriate measuring equipment and apparatus, configure this equipment and apparatus as required for specific tasks and assignments, and combine or assemble it;
- operate measuring equipment and apparatus;
- carry out measurements and series of tests; use electronic data processing for the purpose where appropriate;
- make calculations based on measurements and test series;
- evaluate data collected from measurements and test series, particularly using electronic data processing, and document the results;
- handle materials and equipment correctly, paying due regard to safety and environmental protection regulations;
- have a broad basic education and are able to explain basic scientific contexts relating to their fields of work.

KEY POINTS FROM THE CASE STUDIES

It is clear from our analysis of the frameworks that, regardless of sector, there is only a weak articulation between apprenticeship and the concept of occupation, in contrast to the way apprenticeship is conceived and organised in Germany. We want to highlight five key features.

First, there is vertical and horizontal differentiation in the English frameworks. The vertical differentiation is between intermediate, advanced and Higher apprenticeships, whereas in Germany there is just one apprenticeship level per occupation. Horizontal differentiation takes a variety of forms:

- number of pathways varies
- number of required qualification credits varies within and between pathways; this fragmentation means that apprentices in the same pathway will be achieving different outcomes.
- number of guided learning hours varies within and between pathways
- number of permitted qualifications varies within and between pathways (the same qualification can be available from different awarding bodies)
- number of on-the-job and off-the-job training hours varies within and between pathways and levels
- number and range of job titles and roles listed varies at each level and between pathways

Second, whilst there is a minimum length of 12 months for an apprenticeship, some frameworks 'suggest' the length may be longer. This is in contrast to the German descriptors which specify the mandatory length.

Third, there is no clear specification as to where the off-the-job training will take place or how it will be organised. Again this is in contrast to the German descriptors which specify that the training will take place in both the workplace and the vocational school.

Fourth, there is diversity and inconsistency among the job titles listed within pathways, with no apparent underpinning principles (e.g. level 2 titles for IT include: clerk, technician, administrator, assistant; and level 3 include: helpdesk support, supervisor, manager, officer). The titles between the levels do not overlap, but there is no obvious reason why particular descriptors such as 'officer' and 'helpdesk support' should be level 3 rather than level 2, or why 'manager' and 'supervisor' should both be listed at level 3.

Finally, it is not evident from the framework documents which qualifications should be linked with which job titles/roles.

SECTION 6 CONCLUSION

The evidence we have presented from our case studies of apprenticeship frameworks in three STEM-related sectors (engineering, IT and laboratory technicians) illustrates the inconsistency, lack of standardisation, and complexity of government-supported apprenticeship in England. The case studies revealed that frameworks are organised in different ways, making it hard to access and understand what is demanded of and accrued by a participating apprentice or employer, and how this would compare across frameworks. The lack of clear articulation between apprenticeship levels undermines the frameworks' statements about progression. In particular, there is a risk that Higher Apprenticeships are seen to be positioned as a programme for A-level entrants rather than apprentices progressing from a lower level framework.

The differences in credit values, qualifications and guided learning hours (GLH) within frameworks at the same level and even within the same pathway are confusing (see Appendix 3). Through the concept of minimum standards (e.g. length and credit values), the frameworks allow significant variability in the exchange value they produce and the quality of the training available. Apprentices following the same framework and pathway can complete the programme with very different training experiences and qualification outcomes, and with a knock-on effect on the development of occupational identity and commitment, and sense of what they have 'become'. It is noticeable that frameworks do not always include qualifications that have currency and status in the labour market, which would help to cement occupational identity. One example relates to gardening. Qualifications awarded by the Royal Horticultural Society, such as the level 3 Wisley Diploma in Practical Horticulture, entitle the recipient to call themselves 'Dip. Hort (Wisley)' but this is not included in the apprenticeship.

The fact that apprentices from level 2 to level 5 can be classed as a 'technician' shows that there is no shared understanding of this term and what it might signify in terms of the level of skills required in an occupational field. The government-supported scheme does not prevent the creation and development of 'world class' apprenticeships. There are excellent (often highly over-subscribed) programmes available particularly in engineering and technology. The challenge is achieving consistency. Apprentices' experiences in Germany will of course vary as well. There are numerous personal, pedagogical and organisational factors that can affect an individual's engagement in training, even in a more standardised approach. However, the concept of the *Beruf*, with its statutory specification and accompanying labour market protection, facilitate and support the development of trust and shared understanding of the nature of the training and what completion of an apprenticeship means, and about the fundamental relationship between occupation and apprenticeship.

The comparison between the English and German apprenticeships was revealing. The latter are presented in a way which enables a straightforward impression to be gained about the purpose and occupational concept of the *Beruf*, how long the training will last, the kinds of things it will involve, and where it will take place. The statutory underpinning of the 'dual system' (where all apprentices learn both in the vocational school and in the workplace) means that the inputs and processes associated with the apprenticeship are mandated and the *Berufs* are clearly defined. This stands in sharp contrast to the English approach with its apparently 'anything goes' approach to the inclusion of job titles and roles across and within frameworks. It follows that the English model of apprenticeship is open-ended, with the opportunity for more and more pathways, job titles/roles and qualifications (with their varying credit values and GLH) to be added to frameworks, if it can be shown that there is employer demand. In addition, individuals can take more than one apprenticeship (at different levels) in the same occupational field. This situation exists because the government-supported apprenticeship system (and hence the apprenticeship journey) is not underpinned by a holistic concept of occupation.

Every country's vocational education and training system, and specifically the approach to and design of apprenticeship, reflects and signals its orientation to promoting occupational identity. In the UK, there is a mixed picture. Where apprenticeship has been grafted on to an occupation with a strong history and culture, supported by institutional regulation and professional registration, it is more likely that there will still be a strong connection between occupational identity and apprenticeship. However, although examples of this model are more prevalent in some areas of STEM than in the service sectors, overall the picture is one of a weak relationship. Government-supported apprenticeship is conceived first and foremost as a job. This means that the needs of the employer are privileged in the organisation of education and training, generating the conditions where the apprentice's commitment is associated primarily with the employer rather than the occupation. Employer commitment and apprentices' employed status are significant elements in a successful apprenticeship, but the creation of occupational commitment is important as well. Developing holistic definitions of occupations would entail a shift in the conception of the government-supported apprenticeship programme, as well as triggering reforms to support the recognition of designated apprenticeship occupations in the labour market. We would argue that this approach would strengthen the quality of the programme and its ability to foster occupational identity. It would also make the strengths of the route more transparent for prospective apprentices, employers, parents, careers guidance staff and other stakeholders.

RECOMMENDATIONS

1. Each apprenticeship should be clearly related to one occupational title.
2. The current organisation of apprenticeship in terms of framework, pathway(s) and job roles should be replaced with one specification document per apprenticeship.
3. The detail of each apprenticeship should be provided in standardised format in a document written in clear language. Currently, some frameworks use equivocal terms such as 'an apprentice may be able to ...' and 'could find themselves…' in relation to what they may be doing on an apprenticeship and their occupational career progression options. The revised documents should be made available on the National Apprenticeship Service (NAS) website in a form that makes them easily accessible by the general public. This is vital for effective careers information, advice and guidance.
4. The use of the terms technician and technologist within the apprenticeship frameworks should be reviewed to bring them in line with the Technician Council's stipulation that they should only apply to level 3 and above.

5. The extent to which the frameworks involve the development of STEM-related skills and knowledge needs to be investigated. This includes analysis of curricula and qualifications and also the functional skills requirements.
6. In line with the Richard Review, each apprenticeship should lead to one qualification/ form of certification. There are already qualifications that are recognised and have status in the labour market for entry to skilled employment and, where available, these should be used. This would ensure that every apprentice who completed their programme would know that they had met the requirements for entry to their chosen occupation and had acquired sufficient skills and knowledge to progress within and beyond their immediate job role.
7. To put apprenticeship on a much stronger footing will require government to seriously consider extending the use of mechanisms such as licence to practise and registration of technicians.

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APPENDIX 1 AUSTRALIAN 'TRADES'

Airconditioning and Mechanical Services Plumber
Airconditioning and Refrigeration Mechanic
Aircraft Maintenance Engineer (Avionics)
Aircraft Maintenance Engineer (Mechanical)
Arborist
Automotive Electrician
Baker
Boat Builder and Repairer
Bricklayer
Butcher or Smallgoods Maker
Cabinetmaker
Carpenter
Carpenter and Joiner
Cook
Diesel Motor Mechanic
Drainer
Electrical Linesworker
Electrician (General)
Electrician (special class)
Electronic Equipment Trades Worker
Fibrous Plasterer
Fitter (General)
Fitter and Turner
Fitter-Welder
Floor Finisher
Furniture Finisher
Gasfitter
Glazier
Hairdresser
Joiner
Landscape Gardener
Lift Mechanic
Locksmith
Metal Fabricator
Metal Machinist (First class)
Motor Mechanics (General)
Motorcycle Mechanic
Optical Mechanic
Painting Trades Worker
Panelbeater
Pastrycook
Picture Framer
Plumber (General)
Pressure Welder
Print Finisher
Printing Machinist
Roof Plumber
Roof Tiler

Screen Printer
Shearer
Sheetmetal Trades Worker
Signwriter
Small Engine Mechanic
Solid Plasterer
Stonemason
Telecommunications Linesworker
Telecommunications Technician
Toolmaker
Upholsterer
Vehicle Body Builder
Vehicle Painter
Vehicle Trimmer
Wall and Floor Tiler
Welder (First class)
Wood Machinist

APPENDIX 2 FRAMEWORKS USING THE TERMS 'TECHNICIAN' AND 'TECHNOLOGIST'

- Drinks Dispense Systems level 2 'drinks dispense technician' and 'maintenance team technician'
- Food and Drink level 2 'productivity technician', 'technical assistant', 'equipment technician'
- Food and Drink level 3 'diagnostics technician', 'technical manager'
- Food and Drink level 4 'technical manager'
- IT Software, Web and Telecoms Professionals level 2 'support technician'
- IT Applications Specialist level 2 'website technician'
- Fashion and Textiles level 3 'textile dyeing technician', 'textile technologist', 'analytical textile technologist', 'knitting technician', 'textile colour technologist', 'textile machinery technician', 'garment technologist', 'bespoke footwear technician', 'leather technician/technologist'
- Polymer Processing Operations level 3 'production operator/technician'
- Process Manufacturing level 3 'process operator/technician', 'process engineering maintenance craftsperson/technician', 'downstream field operator/technician', 'refinery control room operator/technician'
- Power Industry level 3 'wind turbine apprentice technician'
- Bus and Coach Engineering and Maintenance level 2 'bus/coach mechanical service technician', 'bus/coach electrical service technician'
- Bus and Coach Engineering and Maintenance level 3 'bus/coach mechanical maintenance and repair technician', 'bus/coach electrical maintenance and repair technician', 'bus/coach diagnostic technician'
- Vehicle Body and Paint level 2 'mechanical and electrical trim technician', 'body building technician', 'panel technician' and 'paint technician'
- Vehicle Body and Paint level 3 'senior mechanical and electrical trim technician', 'senior body building technician', 'senior panel technician' and 'senior paint technician'
- Vehicle Maintenance and Repair level 2 'light vehicle service technician', 'heavy vehicle service technician', 'motor cycle service technician', 'auto electrical technician', 'mobile electrical installation technician', 'heavy vehicle trailer technician', and 'lift truck technician'
- Vehicle Maintenance and Repair level 3 as level 2, but with 'diagnostic' e.g. 'light vehicle diagnostic technician'
- Vehicle Fitting level 2 'fast fit technician/motor vehicle fitter', 'tyre technician'
- Animal Care level 3 'animal management technician'
- Photo imaging level 3 'junior digital imaging technician'
- Accounting level 3 'trainee accounting technician'
- Accounting level 4 'accounting technician'
- Health-Pharmacy Service level 3 'pharmacy technician'
- Technical Theatre level 2 'lighting technician assistant'
- Technical Theatre level 3 'lighting technician'
- Design level 2 'trainee technical illustrator'

- Design level 3 'technical illustrator'
- Glass Industry level 2 'automotive glazing technician/windscreen fitter'
- Glass Industry level 3 'automotive glazing technician/windscreen fitter'
- Production of Coatings level 2 'process technician'
- Production of Coatings level 3 'coating laboratory technician'
- Laboratory and Science Technicians level 2 eighteen titles
- Laboratory and Science Technicians level 3 thirteen titles
- Refrigeration and Air Conditioning level 3 'air conditioning and service maintenance technician'
- Advanced engineering construction level 3 'non-destructive testing technician', 'instrument and control technician', 'electrical maintenance technician', 'mechanical maintenance technician', 'design and drafting technician'
- Construction, technical support and management level 3 'site technician', 'civil engineering technician'
- Land-based engineering level 2 'sport/ground care technician', 'service technician'
- Land-based engineering level 3 'independent technician'
- Horticulture level 3 'horticultural technician'
- Agriculture level 2 'pig technician'
- Agriculture level 2 'livestock technician'
- Surveying level 3 'quantity surveyor technician', building surveyor technician', 'general practice surveyor technician', 'maintenance surveyor technician', 'valuation surveyor technician'
- The Water Industry level 3 'leakage field technician', 'network design technician', 'water distribution technician', 'process operations technician', 'network construction technician', 'wastewater technician'
- The Water Industry level 4 'design technician/project engineer'
- Engineering manufacture craft and technician level 3 twenty-two titles
- Print and printed packaging level 2 'scanning technician', 'proofing technician', 'pre-press technician/plate maker'
- Print and printed packaging level 3 'experienced scanning technician', 'experienced proofing technician', 'experienced pre-press technician/plate maker'
- Building services engineering technology and project management level 3 'building services engineering technician'
- Rail traction and rolling stock engineering level 3 'traction and rolling stock technician'
- Rail infrastructure engineering level 3 eight titles
- Combined manufacturing processes level 3 'paper/product technologist'
- Jewellery, silversmithing and allied trades level 2 'jewellery technician'
- Jewellery, silversmithing and allied trades level 3 'CAD technician'
- Engineering manufacture senior technician level 4 'aircraft systems development technician'
- Extractives and mineral processing occupations level 3 six titles (e.g. 'mines electrical technician')

- Building energy management systems level 3 'Building energy management systems maintenance technician', 'Building energy management systems commissioning technician', 'Building energy management systems installation technician'
- Life science level 5 'life science technician'
- Fashion and Textiles: Technical level 4: six titles with technologist or technical designer
- Nail Services level 2 'junior nail technician'
- Nail Services level 3 'nail technician'

APPENDIX 3 NAS APPRENTICESHIP FRAMEWORKS

CASE STUDY A ENGINEERING MANUFACTURE

INTERMEDIATE AND ADVANCED LEVEL APPRENTICESHIP IN ENGINEERING MANUFACTURE (ENGLAND)
Framework ID: FR2230. Issued by SEMTA

This framework covers a considerable range of occupational fields under the umbrella of engineering manufacture. It states:

There are a very significant range of job titles, roles and occupations within the scope of this framework at levels 2 and 3, but essentially they can be grouped into operator/semi skilled and craft and technician activities within the various sub-sectors. Operator, semi-skilled and craft roles generally being more common within the mature sub-sectors and technician roles pertaining to the leading edge sub-sectors.

The framework has seven pathways at Intermediate level (operator and semi-skilled) and fourteen at Advanced (craft and technician) of which the majority overlap:

Intermediate Pathways: aerospace; marine (ship, yacht, boat building maintenance and repair); mechanical manufacture engineering; engineering maintenance and installation; fabrication and welding; materials processing and finishing; and engineering technical support.

Advanced Pathways: aerospace; marine (ship building maintenance and repair); mechanical manufacture engineering; marine (yacht, boat building maintenance and repair); engineering maintenance; fabrication and welding; materials processing and finishing; engineering technical support; electrical and electronic engineering; installation and commissioning; engineering toolmaking; automotive; engineering woodworking, pattern and model-making; and engineering leadership.

The framework states that the duration of the Intermediate apprenticeships is 'approximately 18 months', and 'approximately 42 months' for the Advanced. There is no definition of the concept of occupation, but in a section profiling the engineering sector in general, the framework states that the key 'sub-occupations' at each level are as follows:

- The main sub-occupations within the craft category include metal working, production and maintenance fitters, welding trades, electricians and electrical fitters, metal machining setters and setter-operators and electrical and electronic engineers.
- The main sub-occupations within the technician category include engineering technicians, draughtspersons, laboratory technicians, and electrical and electronics technicians.

Each pathway is designed to cover a set of 'job roles' and their corresponding 'job titles' (e.g. 'aircraft maintenance fitter' and 'shipwright'). Given the number of pathways, we focus here on the two with the highest (marine) and lowest (materials processing and finishing) requirements for the Intermediate level in relation to credits and guided learning hours (GLH). At Advanced level, however, materials processing and finishing (MPF) has higher requirements than marine. The framework requirements for the two pathways are as follows:

- Intermediate Marine Pathway: 104 credits; total GLH 651 (minimum off-the-job 436 hours and minimum on-the-job 215 hours)
- Intermediate MPF Pathway: 71 credits; total GLH 581 (minimum off-the-job 366 and minimum on-the-job 215 hours)
- Advanced Marine Pathway: 185 credits; total GLH 1218 (minimum off-the-job 794 hours and minimum on-the-job 424 hours)
- Advanced MPF Pathway: 191 credits; total GLH1136 (minimum off-the-job 704 hours and minimum on-the-job 432 hours)

For both pathways, the framework states that the technical certificate is to be delivered through day or block-release (or a combination of the two) in the premises of a training provider or FE college, or on the employer's premises 'away from the immediate pressures of the workplace'.

In terms of progression from the Intermediate and Advanced Apprenticeship, the framework provides the following details for both pathways.

Intermediate

More generally, most ex-apprentices will start off by carrying out semi-skilled job roles within manufacturing and engineering (see job roles described for the pathway). It is likely that a period of consolidation will be required in these roles before progression can take place. Most will aspire to a combination of internal promotion within their companies to team leader or supervisor level, while at the same time this affords the opportunity to undertake Further Education qualifications or an Advanced Apprenticeship to upgrade their competence and knowledge to fully skilled status. The Advanced Apprenticeship offers a choice of 14 occupational sub-sectors such as aerospace, automotive, marine, electrical/ electronics etc. This gives wide-ranging opportunity.

Advanced

While significant numbers of Advanced Apprentices will seek internal progression to team leader or supervisory roles within their companies, some will want to progress to a Higher Apprenticeship in Engineering; others may decide to opt for a Foundation degree or HNC/HND. More generally, most ex-apprentices aspire to a combination of internal promotion while at the same time undertaking company sponsored qualifications as specified above.

These details suggest that the pathways facilitate both internal progression with the apprentice's employer and to higher level qualifications, but the framework directs apprentices to a range of websites to work out for themselves how to navigate the next steps.

HIGHER APPRENTICESHIP IN ADVANCED MANUFACTURING ENGINEERING (ENGLAND)

ID: FRO2278. Issued by SEMTA

The framework has eleven pathways in: aerospace; nuclear related technology; mechanical; electrical/electronics; automotive maintenance; wind generation; research and development; marine, space engineering; and rail engineering. It describes this apprenticeship as follows:

> *The Higher Apprenticeship framework for Advanced Manufacturing Engineering at level 4 has been designed to provide the manufacturing and engineering sectors with high-grade technicians and engineers who have practical skills, combined with a higher education qualification. This will facilitate progression to level 5/6 qualifications and enable them to work towards 'Incorporated Engineer' status. Higher Apprentices will undertake higher-level technical occupations in such sectors as aerospace, nuclear, mechanical, electrical /electronics, automotive, maintenance, wind generation, research and development, marine, space and rail engineering.*

The term 'high-grade technicians' is used, but there is no explanation as to how this differs from the use of the term 'technician' in the advanced apprenticeship. However, in a different section of the framework, the following explanation is given:

The main sub-occupations within the higher-level technical occupations are:

- Technicians: engineering technicians, draftsperson, laboratory technicians, electrical and electronics technicians and quality assurance technicians.
- Professionals: mechanical engineers, design and development engineers, production and process engineers and planning and quality control engineers.
- Managers: production, works and maintenance managers, research and development managers, and quality assurance managers.

It is noticeable that there are only three references to 'level 3' in the framework and each relates to qualification entry requirements. There is no discussion of how this framework articulates with the Intermediate/Advanced framework.

The box provides details of one Pathway 9 (Marine) in this framework.

PATHWAY 9 (MARINE)

The pathway requirements according to age are as follows:
18 to 24[11]yrs (Extended Diploma)
Total minimum credit value = 227
Competence = 107
Knowledge = 120

25yrs plus (Diploma)
Total minimum credit value = 200
Competence = 80
Knowledge = 120

The pathway covers the following job roles (and functions):

- Marine Systems Senior Mechanical Technician: Use diagnostic techniques to identify faults in marine plant, systems and components. Co-ordinate regular planned maintenance to improve serviceability and reduce downtime in production
- Marine Senior Design Technician: Design of marine mechanical, structural systems for bespoke projects using design software. Create production drawings demonstrating regulatory compliance to customer specification
- Marine Electrical/Electronic Senior Technician: Design, develop and manufacture electrical and electronic components and systems for marine based projects ensuring compliance with relevant quality and regulatory procedures
- Marine Senior Quality Technician: Work with engineers to ensure quality programmes are appropriate, maintained and delivered within company procedures (ISO 14001 and 18001)
- Marine Senior Production Technician: Supervise and provide technical guidance to production employees. Resolve technical and production issues within the company, sub-contractors and customers.

Progression from this pathway is outlined as follows:
Progression to the Higher framework for Advanced Manufacturing at level 6

- Employment as a senior technician in marine engineering in a variety of job roles and functions (see job roles)
- This Apprenticeship provides excellent preparation towards professional registration as an Engineering Technician and progression to Incorporated Engineer registration
- It may also, where appropriate, provide progression to a range of honours degrees.

11 There is no explanation in the framework for why the requirements differ by these age bands.

CASE STUDY B INFORMATION TECHNOLOGY

IT, SOFTWARE, WEB & TELECOMS PROFESSIONALS (ENGLAND)
Framework ID: FR00736.). Issued by e-skills UK

There is one framework pathway: Pathway 1: IT, Software, Web & Telecoms Professionals

Minimum levels of off-the-job and on-the-job learning for the pathway are stipulated as follows:

Off-the-job: For each of the Apprenticeship framework levels, a minimum of 100 off-the-job hours per year is required for the first 12 months of the programme, even if the apprentice finishes before the end of the first year. In each subsequent full year, a further 100 hours are required. Should the apprentice finish the programme during a year, the number of hours will be calculated pro-rata based on 100 hours per year. (p.46)

In addition to the minimum number of off-the-job hours, the distribution of hours required to complete the framework across the different components are also listed:

- ***Intermediate Apprenticeship:*** 110 off-the-job hours (70 hours for knowledge, 20 hours for competence, 20 hours for Employee Rights and Responsibilities (ERR))
- ***Advanced Apprenticeship:*** 160 off-the-job hours (120 hours for knowledge, 20 hours for competence, 20 hours for ERR)
- ***Higher Apprenticeship:*** 310 off-the-job hours (270 hours for knowledge, 20 hours for competence, 20 hours for ERR)

On-the-job: For each of the Apprenticeship framework levels, a minimum of 180 on-the-job learning hours per year is required for the first 12 months of the programme, even if the apprentice finishes before the end of the first year. In each subsequent full year, a further 180 hours are required. This includes off-the-job learning time, plus on-the-job coaching and mentoring delivered in addition to normal work activities. Should the apprentice finish the programme during a year, the number of hours will be calculated pro-rata based on 180 hours per year.

As well as the minimum numbers of hours per year, the distribution of hours required to complete the framework across the different components are also listed:

- ***For Intermediate Apprenticeship:*** 200 on-the-job learning hours (200 hours for competence)
- ***For Advanced Apprenticeship:*** 350 on-the-job learning hours (300 hours for competence, 50 hours for knowledge)
- ***For Higher Apprenticeship:*** 700 on-the-job learning hours (490 hours for competence, 210 hours for knowledge). (p. 48)

The apprenticeships in this framework have only one pathway at each of the three levels. Nonetheless, there are two forms of horizontal differentiation within each apprenticeship level. First, in terms of job title/role, there are four titles/roles listed for level 2; six listed for level 3 and five listed for level 4. Second, in terms of knowledge qualifications, there are eight options at level 2, eight at level 3, and three at level 4/5. There is a further level of fragmentation here as some of the knowledge qualification options are offered by more than one awarding body, which means that the 'same' qualification can accrue different Credit Values and different GLH.

IT APPLICATION SPECIALIST (ENGLAND)
FR01983, Issued by e-skills UK

There is one pathway: Pathway 1: IT Application Specialist.

Minimum levels of off-the-job and on-the-job learning for the pathway are stipulated as follows:

Off-the-job: Each ***Intermediate Apprentice*** must receive at least 270 hours of off-the-job learning. This is made up of:

- ITQ units: 115 hours
- Employee Rights and Responsibilities: 20 hours
- Functional Skills (For apprentices without the required levels): 135 hours (p.37)

Each ***Advanced Apprentice*** must receive at least 280 hours of off-the-job learning. This is made up of:

- Core and mandatory units: 125 hours
- Employee Rights and Responsibilities: 20 hours
- Functional Skills (For apprentices without the required levels): 135 hours (p. 37)

On-the-job

- An ***Intermediate Apprentice*** must receive at least 165 GLH of on-the-job learning
- An ***Advanced Apprentice*** must receive at least 155 GLH of on-the-job learning
- PLTS are embedded in the qualifications and the GLH above include an allowance for this. (p. 38)

Although there is only one pathway at each level, there is horizontal differentiation in terms of job title/role (there are four titles/roles at level 2 and four at level 3), and whilst there is a combined qualification at level 2 and level 3, it is offered by eight different Awarding Bodies. Each qualification carries the same credit value, but there are some differences in the number of GLH (the reason for this is not provided). There is no mention in the framework of professional/vendor qualifications such as those offered by Cisco and Microsoft.

An internet search for jobs with the title, 'data administrator', which is one of the job titles listed above, produces examples such as: http://jobview.monster.co.uk/Data-Administrator-Job-Harrow-London-UK-121313750.aspx. This advert asks for a degree or equivalent work background, and advanced MS Excel skills – it doesn't ask for the qualifications available in the apprenticeship framework. There is no indication that completion of the framework confers eligibility for individuals to register with (the) relevant professional body.

CASE STUDY C LABORATORY AND SCIENCE TECHNICIANS

We identified and focused on one framework and note its main characteristics as follows:

LABORATORY AND SCIENCE TECHNICIANS (ENGLAND)
Framework ID: FR00573. Issued by SEMTA

Whilst the title of the framework suggests a broad occupational focus, the specifications outlined within the document indicate a segmented approach to creating job-related apprenticeships. The framework is available at intermediate and advanced levels with the apprenticeship specified in terms of 'pathways' and also job titles.

There are four pathways available at ***intermediate apprenticeship*** level as follows, with the number of associated job titles/roles and minimum credits required to complete the pathway also specified:

- Laboratory and Associated Technical Activities (Education Science): 2 job titles/roles (min 63 credits)
- Laboratory and Associated Technical Activities (Industrial Science): 8 job titles/roles (min 64 credits)
- Laboratory and Associated Technical Activities (Compound Analysis): 6 job titles/roles (min 82 credits)
- Laboratory and Associated Technical Activities (Clinical Analysis): 2 job titles/roles (min 69 credits)

The suggested length for all four level 2 pathways is 18 months. The two main components making up the credit value are competence-based and knowledge-based. There is a choice of competence-based qualifications and knowledge-based qualifications for each pathway accruing a range of credit values.

There are three pathways available at ***advanced apprenticeship*** level as follows, with the number of associated job titles/roles and minimum credits specified:

- Laboratory and Associated Technical Activities (Education Science): 2 job titles/roles (min 88 credits)
- Laboratory and Associated Technical Activities (Industrial Science): 6 job titles/roles (min 100 credits)
- Laboratory and Associated Technical Activities (Analytical and Process Science): 5 job titles/roles (min 111 credits)

The suggested length for all three level 3 pathways is 24 months. The credit value mainly consists of the competence-based and knowledge-based components. There is a choice of competence-based qualifications and knowledge-based qualifications for each pathway. The range of credit values and associated GLH linked to the knowledge-based qualifications varies from 25 credits (GLH 180) to 180 (GLH 1080) credits within each pathway. All the competence-based qualifications available for each pathway have the same credit value. However, the size of the credit value varies between pathways (48 in pathway 1, 60 in pathway 2, and 71 in pathway 3).

The framework suggests that approximately two-thirds of the GLH associated with each pathway should be allocated to off-the-job training, and one-third to on-the-job training in pursuit of the competence and knowledge-based components, functional skills and employment rights and responsibilities (ERR). The total suggested GLH varies across the pathways (812 in pathway 1, 830 pathway 2, and 828 pathway 3).

For an apprentice to complete a level 2 apprenticeship and then move on to complete a level 3 apprenticeship would take approximately three and a half years.

APPENDIX 4 GERMAN OCCUPATIONS

COMPARISON WITH GERMANY: ENGINEERING

We provided details of one of the range of engineering-related occupations listed on the BIBB website 'Boatbuilder' in the main report (page 20). For the purposes of further illustration here, we provide details of three more from the list using the sub-headings that appear on the website: Mechatronics Fitter; Production Mechanic; and Materials Tester. In each case, there is a succinct explanation of the occupation followed by the skills to be covered during training.

MECHATRONICS FITTER

DESIGNATION OF OCCUPATION: Mechatronics Fitter (M/F)

Recognized by ordinance of 4 March 1998 (BGBl. I, p. 408)
http://www.bibb.de/en/ausbildungsprofil_2262.htm

DURATION OF TRAINEESHIP: 3.5 years
The venues for training are company and vocational school *(Berufsschule)*

FIELD OF ACTIVITY
Mechatronics fitters are engaged in the assembly and maintenance of complex machines, plant and systems in the mechanical engineering sector or in organizations which purchase and operate such mechatronic systems.

OCCUPATIONAL SKILLS
Mechatronics fitters carry out their work at various places, mainly at plant assembly sites, in workshops, and in connection with service operations. They are qualified to work autonomously on the basis of technical documents and instructions, and they carry out their work in compliance with the relevant provisions and safety regulations. They often work in teams. They coordinate their activities with upstream and downstream operations. Under the provisions of the Prevention of Accidents Regulations, mechatronics fitters are deemed to be specialists in the electrical and electronic engineering field.

Mechatronics fitters:

- plan and control work processes, monitor and evaluate the results and apply quality management systems;
- process mechanical parts and assemble sub-assemblies and components into mechatronic systems;
- install electrical sub-assemblies and components;
- measure and test electrical values;
- install and test hardware and software components;
- build and test electrical, pneumatic and hydraulic control systems;
- program mechatronic systems;
- assemble, dismantle, securitize and transport machinery, systems and plant;
- set up and test the functioning of mechatronic systems;
- undertake the commissioning of mechatronic systems and operate such systems;
- deliver mechatronic systems to clients and provide training in their operation;
- carry out maintenance operations on mechatronic systems;
- work with English-language technical documents and also communicate in the English language.

PRODUCTION MECHANIC

DESIGNATION OF OCCUPATION: production mechanic

Last modified on: December 12, 2006
http://www.bibb.de/en/ausbildungsprofil_1882.htm

DURATION OF TRAINEESHIP: 3 years
The venues for training delivery are the training company and the vocational school

FIELD OF ACTIVITY
Production mechanics are mainly involved in the assembly/manufacturing of series-produced industrial goods. They usually carry out their work in teams within the framework of a manufacturing process, where they are directly involved in ensuring operational continuity and compliance with quality standards and in measures to continuously improve process procedures, manufacturing quality and work safety.

OCCUPATIONAL SKILLS
Production mechanics (m/f):

- recognize their tasks from assembly plans, maintenance schedules, production drawings and operating instructions,
- discuss and agree on the allocation of tasks within the team,
- assemble components to form sub-assemblies and sub-assemblies to form complex machines, plant, equipment or motor vehicles,
- lay, fasten and connect up electrical wiring, components and sub-assemblies,
- test and adjust the functioning of sub-assemblies or finished products,
- are responsible for monitoring workmanship and carrying out any necessary remedial procedures,
- use the machines, assembly devices, transportation equipment and tools available for their work,
- contribute to team discussions on improving process safety and quality, on optimizing team workplaces and on the coordination of activities within the team,
- keep records of and interpret statistics, in particular quality data,
- cooperate with upstream and downstream divisions, particularly with regard to information relevant to ensuring operational continuity,
- carry out the necessary adjustment, maintenance and servicing work on installations, machines and tools which they use.

MATERIALS TESTER

DESIGNATION OF OCCUPATION: materials tester (m/f)

Last modified on: July 30, 2007
http://www.bibb.de/en/ausbildungsprofil_2313.htm

DURATION OF TRAINEESHIP: 3.5 years
Training is provide in one of three specialist areas:

- metallurgy
- semi-conductor technology
- heat treatment technology

FIELD OF ACTIVITY
Materials testers are qualified to work unaided, examining materials and workpieces and using technological processes to alter their properties. They have basic metalworking skills. Detailed knowledge of the preceding production and processing steps enables them to analyse the causes of faults that have been identified, and thus to gain information on preventing such faults. Testing methods are generally governed by standards or other sets of rules in relation to method of execution, presentation of results and quality assurance.

OCCUPATIONAL SKILLS
Materials testers specialising in metallurgy:

- examine materials submitted, primarily semi-finished metal products and metal workpieces and materials, for internal or external faults and test to ensure the maintenance of product quality;
- carry out investigations in the event of a failure in order to establish the cause of the failure;
- establish material properties, e.g. hardness, strength, ductility, generally using destructive and non-destructive test procedures;
- prepare materials and inspect them microscopically for grain size, occlusions, arrangement of structure, etc.;
- document all results and test their plausibility.

Materials testers specialising in semi-conductor technology:

- work in the semi-conductor industry, and carry out tests and intermediate and final inspections on semi-conductor materials and components using specific investigation procedures;
- follow through the processes involved in the production of semi-conductor components from the silicon wafer stage to the finished product, the integrated circuit (chip);
- examine and analyse faulty products in order to obtain information on production irregularities;
- work in a self-reliant manner to carry out all the necessary individual quality assurance steps and assess the end results.

Materials testers specialising in heat treatment technology:

- apply different heat treatment processes to metals and metal workpieces which are likely to have to withstand particular stresses;
- adjust workpieces to specified tolerances;
- operate, control and maintain plant, machinery and furnaces used in the heat treatment process, particularly in the hardening process;
- investigate the results of heat treatment.

COMPARISON WITH GERMANY: IT

There are five German IT occupations listed on the BIBB website as follows:

1. Information and telecommunications system support specialist (m/f)
   http://www.bibb.de/en/ausbildungsprofil_2109.htm
   Last modified on December 12, 2006
2. Information technology and telecommunications system electronics technician (male/female)
   http://www.bibb.de/en/ausbildungsprofil_1875.htm
   Last modified on December 12, 2006
3. Information technology officer (male/female)
   http://www.bibb.de/en/ausbildungsprofil_1871.htm
   Last modified December 12, 2006
4. Information technology specialist (m/f)
   http://www.bibb.de/en/ausbildungsprofil_1840.htm
   Last modified December 12, 2006
5. Information electronics technician (last modified July 30, 2007)
   http://www.bibb.de/en/ausbildungsprofil_1873.htm

The format for presenting summary information relating to all apprenticeship occupations is standardised under four headings:

- Designation of occupation
- Duration of traineeship
- Field of activity
- Occupational skills

The specification for Information and telecommunication support specialist was included in Section 5 above. Here we include one further IT occupation, Information technology specialist, for illustrative purposes, as follows.

INFORMATION TECHNOLOGY SPECIALIST

DESIGNATION OF OCCUPATION: Information technology specialist (m/f)

http://www.bibb.de/en/ausbildungsprofil_1840.htm

DURATION OF TRAINEESHIP: 3 years

Training is provided in one of the following specialist areas:

- applications development
- system integration

The venues for training delivery are the training company and the vocational school.

FIELD OF ACTIVITY

Information technology specialists translate specialist requirements into complex hardware and software systems. they analyse, plan and produce information technology and telecommunications systems and introduce new or modified systems. They provide customers and users with technical advice, support and training.

Typical areas of applications development in which they work are commercial, technical, expert, mathematical and multimedia systems.

Typical areas of system integration in which they work are computing centres, networks, client/server systems, fixed networks and radio networks.

OCCUPATIONAL SKILLS

Information technology specialists working in applications development:

- design and produce customized software applications,
- test and document applications,
- modify existing applications,
- apply project planning, implementation and control methods,
- use software development tools,
- develop ergonomically designed user interfaces for specific applications,
- rectify faults through the use of expert and diagnostic systems,
- present applications,
- advise and train users.

Information technology specialists working in system integration:

- design and produce complex information technology and telecommunications systems by integrating hardware and software components,
- install and configure networked information technology and telecommunications systems,
- commission information technology and telecommunications systems,
- apply project planning, implementation and control methods,
- rectify faults through the use of expert and diagnostic systems,
- administer information technology and telecommunications systems,
- present system solutions,
- advise and train users.

COMPARISON WITH GERMANY: LABORATORY TECHNICIANS

A search of the BIBB occupations website (http://www.bibb.de/en/26171.htm, accessed 19 July 2013) using the term 'laboratory' revealed the availability of six apprenticeship *Berufs* as follows:

- Physics laboratory technician
  http://www.bibb.de/en/ausbildungsprofil_2267.htm
- Chemical laboratory technician
  http://www.bibb.de/en/ausbildungsprofil_1774.htm
- Biological laboratory technician
  http://www.bibb.de/en/ausbildungsprofil_1690.htm
- Lacquer and varnish laboratory technician
  http://www.bibb.de/en/ausbildungsprofil_2167.htm
- Photographic media laboratory technician
  http://www.bibb.de/en ausbildungsprofil_1892.htm
- Textiles laboratory technician.
  http://www.bibb.de/en/ausbildungsprofil_14393.htm

The first three titles indicate that they are located within a specific scientific discipline, whereas the last three are located with a specified vocational or sectoral field. The duration of the photographic media laboratory technician is three years; the five others last three and a half years. They all involve participation in the vocational school as well as the training company – the hallmark of the dual system. The structure of the apprenticeship specification is the same in all cases, and identical to all other occupations in the German system (see the Engineering and IT examples above). To illustrate we included the specifications for one of the scientific discipline-based occupations – the Physics laboratory technician in Section 5. Here we include one of the more clearly sectorally-related occupations – the Lacquer and varnish laboratory technician.

LACQUER AND VARNISH LABORATORY TECHNICIAN

DESIGNATION OF OCCUPATION: Lacquer and varnish laboratory technician
Recognized by ordinance of March 22, 2000 (BGBl. I p. 257)

DURATION OF TRAINEESHIP: 3.5 years

The venues for training are the company and part-time vocational school *(Berufsschule)*

FIELD OF ACTIVITY
Lacquer and varnish laboratory technicians work in a team and on projects in development and testing laboratories in the chemical industry, in industries producing and using lacquers and varnishes, and in the research and development laboratories of institutes.

Their spectrum of tasks includes the formulation, production, application and testing of coatings, coating materials and coating systems, as well as advising customers.

In the areas of research, development, quality control, application technology and environmental protection, they carry out measurements and investigations independently, and evaluate and document the results, using electronic data processing systems. They exercise great responsibility in observing the rules and regulations of work safety, health protection, environmental protection and quality assurance, in particular.

Lacquer and varnish laboratory technicians have a broad-ranging basic knowledge of application technology. Depending on the company's focuses, they have also acquired specialist knowledge and abilities in the third stage of their training.

OCCUPATIONAL SKILLS
Vanish and lacquer laboratory technicians:

- test raw materials and primary products by physical and chemical methods;
- determine properties of coating materials, inferring applications;
- put together formulations for coating materials and coating systems in accordance with specific requirements and customer orders;
- produce coating materials, independently selecting the work techniques and equipment to be used;
- establish coating technology parameters and check the resistance of coatings to physical and chemical stress and strain;
- assess the surface quality of undersurfaces and coatings;
- evaluate measurement and experimental data, in particular using electronic data processing systems, and document results;
- apply coating materials manually and using automatic techniques;
- observe relevant safety and environmental regulations when working with substances, equipment and apparatus;
- advise customers;
- use quality management methods in carrying out their work.

The specifications present a broad picture of the occupation, through the term 'field of activity' and the accompanying descriptor. The occupational skills are defined in broad or generic terms without reference to the particular needs of an individual employer. In relation to the textile laboratory technician, the outline of the field of activity indicates that in the final (third) stage of the training there is scope for the provision to be tailored more closely to the requirements of the training company.

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