EMPLOYER INVESTMENT IN INTERMEDIATE-LEVEL STEM SKILLS: HOW EMPLOYERS MANAGE THE INVESTMENT RISK ASSOCIATED WITH APPRENTICESHIPS

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EXECUTIVE SUMMARY

There is a demand in the UK labour market for intermediate-level STEM skills which Apprenticeships can help to meet. STEM Apprenticeships can offer potentially substantial wage returns to individuals who complete them, and productivity gains to employers. The benefits to employers that train STEM apprentices include avoiding skill shortages, and obtaining a relatively good fit between the content of training and the needs of the business.

Employers invest in Apprenticeships such as those at Level 3 in engineering because they are convinced of the benefits of doing so. However, the cost to the employer of taking on an apprentice is relatively high. Estimates indicate that, at the end of the training period, an employer that has delivered a Level 3 Engineering Apprenticeship will face a net cost of around £40,000. This can take an employer around three years after the end of formal training period to recoup.

If the number of apprentices is to substantially increase, then there is a need to find some way of persuading more employers to invest in this form of training. In considering this issue, some thought needs to be given to the risks faced by employers who may be interested in taking on apprentices.

Employers face two key risks in delivering an Apprenticeship. These are to do with being able to:

- appropriate the return on their investment. The employer may not be able to recover the net cost they face at the end of the formal Apprenticeship training period because, for example, the apprentice leaves their employment;
- successfully deliver the various elements of the Apprenticeship such that apprentices successfully complete their Apprenticeships. Some employers, particularly SMEs or those new to Apprenticeships, may not have the expertise or resources in-house to be able to deliver the various elements prescribed under the relevant framework.

If some means can be found of reducing the risk faced by the employer in delivering an Apprenticeship, then it may be possible to increase the number of Apprenticeship starts and completions. However, this risk reduction must be achieved without subverting the overall aim of national policy to bring about a more demand-led, high-quality Apprenticeship system where the employer, a principal beneficiary of this form of training, is required to make a financial contribution to the training providers' costs.

There are various means through which employers participating in STEM Apprenticeships are able to retain the services of their former apprentices and thus offset their training costs. For instance, one of the most important aspects of an Apprenticeship is the bond that develops between the employer and the apprentice over the training period. Since the apprentice is schooled in the employer's values and ways of doing things, they may be more likely to continue working for their employer after their Apprenticeship.

There is also the potential for the employer to shape the content of Apprenticeship training such that it delivers organisation-specific skill mixes. In this way, the bond (or lock) between employer and apprentice is further reinforced.

This also, potentially, reduces the risk of other employers poaching, by imposing additional training costs to the non-training employer.

As well as increasing the likelihood of an apprentice remaining with their employer, Apprenticeships could be made more attractive by reducing the delivery costs. The evidence provided in this report demonstrates a number of ways in which costs to employers could be reduced, including:

1. Reducing the wage rates of apprentices to reflect average levels paid in Switzerland or Germany. If the wage rates of apprentices working towards completion of a STEM Apprenticeship in England were reduced to the average levels paid to apprentices in Switzerland or Germany, this decrease could reduce the current overall cost that the employer faces at the end of a three- to four-year engineering Apprenticeship.

2. Increasing the productivity of apprentices. Similar to point 1: if, as in the Swiss Apprenticeship system, apprentices were more productive, then this activity could also further reduce the net costs of Apprenticeships to the employer. In this way, the employer could recoup much of their investment in the apprentice by the end of the formal training period. Therefore, even if they were to lose the apprentice at the end of the training, they might not be out of pocket.

3. Increasing economies of scale, for example through pooling resources (e.g. supervision of apprentices) across employers. Supervisory costs constitute a relatively large share of overall training costs in a STEM Apprenticeship. Many employers typically take on one or two apprentices a year, so there is limited scope to accrue economies of scale. However, pooling resources, for example through Group Training Associations (GTAs) or Apprenticeship Training Agencies (ATAs), could increase the economies of scale achieved in delivering an Apprenticeship, thus further reducing the cost to the employer. This strategy could be particularly valuable for small employers who tend to have fewer apprentices at any given point in time. Evidence provided in this report describes the way in which some employers have organically developed a group-style approach to training. In this arrangement, employers, that are either at the head of the supply-chain or are dominant local ones, provide a training resource which companies in their supply chain or others locally can draw upon. A further benefit of being able to pool resources is that it allows employers concerned about being able to manage the process of delivering an Apprenticeship to draw on the expertise of others. This tends to help the employer, especially smaller ones with less experience of Apprenticeship training, to manage the second risk factor identified above.

If the number of STEM Apprenticeship starts is to increase, further consideration needs to be given to the overall level of risk an employer faces in delivering this form of training. By considering how employers can reduce the costs of training an apprentice, while ensuring they can successfully deliver the training required, a means of increasing the number of apprentices may have been identified.

SECTION 1 INTRODUCTION

Two points need to be made at the outset. First, throughout the report Apprenticeship has an upper case A to indicate that reference is being made to the publicly funded programme. This distinguishes it from the wider body of training that falls under the rubric of apprenticeships and which has its origins in the medieval guilds.

Second, the principal interest of the report is on STEM-related Apprenticeships in general but the focus in much of the report is upon a specific type of STEM Apprenticeship: that of engineering delivered at Level 3.

1.1 THE IMPORTANCE OF STEM APPRENTICESHIPS

Much of the UK's industrial strategy is predicated on the success of its hi-tech industries. In turn, this places an emphasis on the supply of Science, Technology, Engineering and Mathematics (STEM) skills. There has been much emphasis on the role of higher education in supplying these skills, but the evidence also points to a substantial skill demand at an intermediate / technician level where Apprenticeships can play an important role in supplying STEM skills.

There is a wealth of evidence that demonstrates the value apprentices confer upon the employers who train them. This is particularly so with respect to STEM Apprenticeships. However there remains the challenge of persuading more employers to invest in STEM Apprenticeships, in order to avoid skill shortages arising that have the potential to stymie the development of hi-tech growth sectors. The challenge is essentially that of persuading more employers to make relatively costly investments in intermediate-level STEM skills. Evidence, from the Institute for Employment Research's (IER) Net Costs and Benefits of Training to Employer series of studies[1], suggests that at the end of a three- to four-year engineering Apprenticeship – a fairly typical STEM Apprenticeship – an employer will have accrued a net cost of around £40,000 for each apprentice trained. This is after factoring in the productive contribution of the apprentices over the training period.

Employers will only make an investment of around £40,000 if they are convinced that they will be able to obtain a suitable return. IER estimates indicate, for instance, that should employers be able to retain the services of an engineering apprentice post-Apprenticeship, they will be able to recover the cost of training them in around three years. Nevertheless, an upfront cost of £40,000 is, potentially, a barrier to many employers taking on a STEM apprentice.

Persuading more employers to take on apprentices may lie in understanding how employers manage the risk attached to investments in skills. There are lessons to be learnt from other countries. In Germany, historically, the net cost to the employer of delivering an Apprenticeship has been relatively high compared with Switzerland. Given that Germany has a relatively inflexible labour market, employers there, arguably, face less risk in making large investments in Apprenticeship training because they can be reasonably assured that they will be able to appropriate the returns from that investment. This is because in a relatively inflexible labour market, the chances of the former apprentice switching employers post-training are lower than in situations

1 See the latest in the series: Hogarth, T., Gambin, L., Winterbotham, M., Baldauf, B., Briscoe, G., Gunstone, B., Hasluck, C., Koerbitz, C. and Taylor, C. (2012) *Employer Investment in Apprenticeships and Workplace Learning: The Fifth Net Benefits of Training to Employers Study, BIS Research Paper No. 67*

where there is a flexible labour market. Employers in Switzerland, in contrast, where there is a more flexible labour market, are more likely to look to recoup the cost of Apprenticeship training over the formal training period, because they face more of a risk of losing their apprentices once they have completed their training.

In the UK – a highly flexible labour market – the cost to the employer of delivering a STEM Apprenticeship is relatively high, as indicated above. Accordingly, employers have sought to ensure the apprentice stays with the company post-Apprenticeship through a variety of means. The evidence collected since 1996, from the Net Costs and Benefits of Training to Employer series of studies[2], indicates that employers offering engineering and other STEM Apprenticeships are well versed in how to retain the services of the apprentices they train. This is observed in the rigorous recruitment process, the instillation of company values in apprentices during the training period, and well mapped-out avenues of career progression in the firm post-Apprenticeship. Hence employers are able to recoup their costs.

Employers much less experienced in Apprenticeships may be less confident that they will be able to secure the same kind of returns as their more experienced counterparts. One means of circumnavigating this issue is to establish partnerships between experienced and less experienced employers. This has been explored in research on Group Training Associations (GTAs)[3], but there are more informal approaches whereby a large employer is willing to train the apprentice of a smaller, local company or one in its supply-chain. They thereby become a type of group trainer. This approach tends to minimise the risk to the smaller / supply chain company, because the larger company uses its experience and resources to guide the apprentices through their training, and it potentially increases the viability of Apprenticeship training in the larger company because it improves their economies of scale.

Drawing on research[4] IER has undertaken on employer demand for STEM Apprenticeships, consideration is given to how this form of group approach may provide a means of increasing the demand for, and supply of, STEM skills.

1.2 AIMS OF THE STUDY

The aims of the study on which this report is based are:

1. To provide a review of the concept of risk relating to employer investment in STEM Apprenticeships. The aim is to look at this from the perspective of the Apprenticeship system in England, and the role of policy in sharing and shifting the cost of Apprenticeships between the employer, the apprentice, and the State. From a policy perspective, insights will also be provided from Germany and Switzerland on how these countries have been able to persuade employers to invest in Apprenticeship training.

2. Given the policy context, evidence will be drawn from the employer case studies IER has conducted since 1996 on the cost and benefits employers derive from investing in STEM Apprenticeships. This will provide insights into

2 *ibid*

3 See for example, Unwin, L. (2012) *Report of the Commission of Inquiry into the Role of Group Training Associations.* London: Institute of Education / LLAKES; CFE (2013). *Apprenticeship Training Agency Model: An independent review of progress, prospects and potential.* Coventry: Learning and Skill Development Service.

4 Hogarth et al (2014) *op cit;* McCaig C., Hogarth T., Gambin L. and Clague L. (2014) *Research into the need for and capacity to deliver STEM-related apprenticeship provision in England,* BIS Research Paper No. 171. London: Department for Business, Innovation and Skills.

how employers have, in practice, managed the financial risks associated with investing in Apprenticeships.

3. From the evidence in (1) and (2) it will be possible to highlight relatively effective approaches to managing risk from the employer perspective. This provides some pointers to indicate how public policy on Apprenticeships can be augmented to bring about higher levels of employer demand for STEM Apprenticeships.

1.3 STRUCTURE OF REPORT

The report commences with an overview of the demand for, and supply of, STEM Apprenticeships in England, and the extent to which there may be under-supply of key skills that Apprenticeships are well placed to provide. Contextual information is also provided about development in Apprenticeship policy over recent years. In Section 3, an outline of the rationales that guide employer investments in STEM Apprenticeships is provided, along with the costs they face, and how employers recoup these costs. This is followed by a section that looks at how the take-up of STEM Apprenticeships might be extended beyond the group of employers which currently provide them. This focuses in particular upon how collective or group measures might be used to achieve this aim. Finally, a conclusion is provided that outlines how policy might be augmented to increase the number of employers offering STEM Apprenticeships.

SECTION 2 THE DEMAND FOR, AND SUPPLY OF, STEM APPRENTICESHIPS

2.1 DEFINING INTERMEDIATE-LEVEL JOBS AND APPRENTICESHIPS

The principal interest is in how Apprenticeships can meet the demand for intermediate-level STEM skills. Defining intermediate-level skills is not straightforward. Generally this refers to jobs that are considered to embody a level of conceptual difficulty below that of a managerial or professional job, but above that required in routine manual and non-manual jobs. Table 1 outlines how intermediate-level jobs might be defined with reference to occupation and qualification.

Table 1: Intermediate-level jobs defined with reference to occupation and qualification, 2014

Occupational group (SOC 1-digit)	% of total employment	% higher level	% intermediate level	% lower level	Designation
1. Managers, directors and senior officials	11	32	36	32	Higher level
2. Professional occupations	20	42	36	22	
3. Associate professional and technical	14	29	38	33	
4. Administrative and secretarial	11	13	29	59	Intermediate level
5. Skilled trades occupations	11	5	41	54	
6. Caring, leisure and other service	9	10	28	61	Lower level
7. Sales and customer service	8	17	32	52	
8. Process, plant and machine operatives	6	2	22	76	
9. Elementary occupations	10	2	14	84	
	100				

Source: Working Futures database

If intermediate level is defined with reference to administrative and skilled trades jobs, it is immediately apparent that there are many other occupational groups with a similar level of people qualified at an intermediate level. If an intermediate-level qualification is defined with reference to QCF Levels 3, 4 and 5 (equivalent to obtaining a qualification somewhere between achieving two A-levels and sub-degree level), then it is apparent that many other occupations in addition to skilled trades ones have a similar percentage of their employees qualified at this level.

Given that the interest is in STEM-related jobs at the intermediate level, one might wish to define intermediate-level jobs with reference to those that have a technology / engineering focus within the skilled trades and associate professional occupational groups. These two occupational groups have a similar percentage of their workforce educated to an intermediate level, and contain jobs with a technological / scientific focus. Figure 1 depicts the jobs within these two occupational groups with such a focus, and the highest qualification level held by employees in these jobs. As can be seen, nearly all have a relatively high percentage, compared with all occupations, of employees qualified at an intermediate level (QCF levels 3 to 5).

Figure 1: Qualification levels in skilled trades and associate professional jobs

Source: Working Futures database, own calculations

It will be typically Apprenticeships at Levels 3, 4 and 5 which comprise these intermediate-level skills. Table 2 below gives an indication of the Apprenticeship frameworks – mainly at Level 3 at this stage – that are relevant to each occupational group. The listing is not definitive, but it gives an indication of the types of Apprenticeship that are in mind when analysing the demand for intermediate-level STEM Apprenticeships.

Table 2: Examples of Apprenticeship frameworks relevant to associate professional and skilled trades STEM occupations

Occupational group	Apprenticeship frameworks
31	Laboratory and science technicians
	Electro-technical
	Various rail technology / engineering technician apprenticeships
	Composites technicians
	IT technicians
32	Pharmacy services, dental and optician technicians
52	Engineering manufacture
	Building & services engineering
	Food and drink maintenance engineer
	Various transport (land, air, sea) engineering, maintenance and repair
	Mechatronics
	Product design & development
	Laboratory technician
	Science manufacturing technicians
53	Construction engineering
	Heating and ventilating
54	Photo-imaging in textiles

2.2 THE IMPORTANCE OF INTERMEDIATE-LEVEL STEM SKILLS

There is strong evidence about the relative employment and wage returns that accrue to the individual from completing an Apprenticeship, versus something similar at a comparable attainment level.[5] This does not mean that the benefits are directly due to Apprenticeship training, since those who complete this form of vocational training may be inherently more productive.[6] There is, however, a substantial body of evidence which consistently indicates that completion of an Apprenticeship is associated with relatively good employment returns to the individual. Apprenticeships, however, cover a wide variety of training. Of interest is identification of the particular Apprenticeships that are associated with the highest returns. Here the evidence is much thinner on the ground. But what there is suggests that returns are higher, certainly for men, where an engineering / manufacturing-related Apprenticeship has been completed.[7] This is consistent with evidence from higher education that consistently points to higher wage and employment returns associated with STEM degrees.[8]

If STEM skills are associated with relatively high rates of return to individuals, this implies that their employers are obtaining a return from their skills too (unless the employee is able to wholly appropriate the return on their skills).[9]

5 Bibby, D. *et al.* (2014) *Estimation of the labour market returns to qualifications gained in English Further Education,* BIS Research Paper No. 195

6 Gambin, L. et al. (2014) *Methodological Issues in Estimating the Value Added of Further Education and Skills: A review of relevant literature.* BIS Research Paper 166,

7 McIntosh, S. (2007) *A Cost-Benefit Analysis of Apprenticeships and Other Vocational Qualifications*. Department for Education and Skills Research Report RR834

8 Walker and Zhu (2013). 'The impact of university degrees on the lifecycle of earnings: some further analysis. BIS Research Paper Number 112. London: Department for Business, Innovation and Skills.

9 Somewhat dated evidence suggests that where employers train their employees, the monetary return is shared between employer and employee.

It is recognised that there is a virtuous circle whereby innovation, research and development, skills, enterprise, and competition mutually reinforce one another to bring about productivity growth. The skills most frequently cited in relation to innovation are STEM ones, typically ones produced by higher education rather than Apprenticeships.[10] It stands to reason that where companies are engaged in innovation and, subsequently, the manufacture of prototypes, bespoke products, and such-like, that there will be a cadre of skilled technician / craft employees as well.[11] STEM skills produced through the Apprenticeship system are therefore likely to play an important role in enhancing organisational performance in key sectors of the UK economy. The crux of the matter is whether a sufficient number of employers can be persuaded to make the investment in STEM Apprenticeships at Level 3.

2.3 THE DEMAND FOR INTERMEDIATE-LEVEL STEM SKILLS

The interest here is in the demand for intermediate-level skills. Previous research, for instance, has indicated the relative importance that countries such as Germany and the Netherlands place upon intermediate-level skills in the workplace. It is one of the factors explaining their relatively good economic performance over recent decades.[12] It is also apparent that these two countries, amongst others, have well-established, highly regarded initial vocational education and training (IVET) systems at an intermediate level. It is perhaps no surprise that there is much interest in raising intermediate-level skills supply in the UK.[13] The Richard Review,[14] for example, advocates reform of the Apprenticeship system so that it is oriented towards providing qualifications at Level 3 and above, rather than at both Level 2 and 3, as at present. Similarly, the Government has signalled its desire to increase the number of technicians in the economy; that is, people occupying para-professional roles typically allied to scientific, engineering and technical (SET) skill needs within the workplace.[15]

How much demand there is for intermediate-level skills is something of a moot point. With respect to technicians working in SET roles, the evidence suggests a long-run decline in the numbers employed, if technicians are considered to span the skilled trades and associate professional occupational groups.[16] Other evidence points to a hollowing-out of the labour market, whereby the growth in high- and low-skilled jobs (however defined) has been greater than that of middle-skilled ones.[17] The evidence would suggest that the skilled jobs in the middle of the occupational hierarchy have declined in both absolute and relative terms in the UK.[18] There are a number of factors underlying this trend, including:

10 BIS Innovation report 2014, Innovation, Research and Growth

11 Lewis, (2012a) Flying High: A Study of Technician Duties, Skills and Training in the UK Aerospace Industry. London: Gatsby Charitable Foundation; Lewis (2012b) *Space for Technicians? An Analysis of Technician Duties, Skills and Training in the UK Space Industry.* London: Gatsby Charitable Foundation

12 Mason, G. (2012) *Science, Engineering and Technology Technicians in the UK Economy.* London: Gatsby Charitable Foundation

13 It should be noted that in countries such as Germany, before the Bologna process was introduced, higher education was typically delivered at a Masters level, which meant that the dual training system leading to an intermediate-level qualification proved to be an attractive alternative for both young people and employers.

14 Richard, D. (2012). *The Richard Review of Apprenticeships.* London: Department for Business Innovation and Skills.

15 Mason, G. (2012) *op cit;* Lewis (2012a) *op cit;* Lewis (2012b *op cit*

16 Jagger, N. et al. (2010) *SET-based Technicians: Lessons for the UK and European Labour Force Surveys,* Institute for Employment Studies Report No.475

17 McIntosh, S. (2013). *Hollowing out and the future of the labour market.* BIS Research Paper 134

18 Goos, M. and Manning, A. (2007). "Lousy and lovely jobs. The rising polarization of work in Britain". The Review of Economics and Statistics, 89(1), 118-133; Holmes, C. and Mayhew, K. (2012). The Changing Shape of the UK Job Market and its Implications for the Bottom Half of Earners. Resolution Foundation Report.

1. task-based technological change;
2. offshoring;
3. the impact of increasing wage-inequality on occupational demand.

The explanation which has received the most attention is the theory of task-based technological change.[19] Technological change is seen to have most impact on routine jobs, which do not require their incumbents to respond to outside stimuli. Accordingly their jobs can be replaced by technology which automates the tasks they once carried out. It has been observed that routine jobs, susceptible to being replaced by automation, are typically found in the middle of the occupational structure: administrative jobs and skilled production jobs.[20] Higher-level skilled jobs which require their incumbents to utilise cognitive skills cannot readily be substituted by automation, and lower skilled jobs, such as those found in hospitality, require their incumbents to interact with customers so they too are not readily automated. But this is not to write off the importance of skills supply at an intermediate level as will be indicated below.

An analysis of the engineering sector from the early 2000s showed the link between product lifecycles and skill needs.[21] It demonstrated that as products moved from R&D phases, to the development of small batches, and then to mass production, skill needs changed: from a mix of high and intermediate-level skills required to design and produce prototypes and small production runs, to the use of automation as products became commodified, with a requirement for managerial control of mass production systems linked to machine-minding roles on the shop-floor. The report noted that relatively high profits could be obtained from mass production, but much of the employment associated with it was often offshore and relatively low skilled. The relatively high skill, high value activity was in the design and development of relatively complex products that typically required a mix of high and intermediate-level skills. This further emphasises the importance of intermediate-level STEM skills to the performance of the engineering / manufacturing sector.

Nevertheless, at face value the hollowing out of the labour market hypothesis suggests that there will be a declining demand for those who are required to work in intermediate-level occupations within sectors, such as manufacturing, with a strong demand for STEM skills. Why then is there a need to increase the supply of skills, via Apprenticeships or other forms of training, at the intermediate level? The simple answer is the level of replacement demand; in other words, the number of people who are expected to exit an occupation and will therefore need to be replaced. Even though the number of people in some of those industries, where many people with STEM skills are based, is projected to decline over the next ten years or so, because there are likely to be a substantial number of retirements over the same period in these industries, there will be a substantial number of jobs to be filled.

Based on the Working Futures projections of skill demand, Table 3 provides an indication of projected employment trends in the manufacturing sector to 2020. It shows that the overall number of people employed in occupations such as skilled trades occupations, to which an Apprenticeship will typically provide entry, is likely to

19 Autor, D., Levy, F. and Murnane, R. (2003). "The skill content of recent technological change: an experimental exploration". *Quarterly Journal of Economics*. 118(4), 1279-1333

20 Goos, M. and Manning, A. (2007) *op cit*

21 Davis, C., Buckley, T., Hogarth, T. and Shackleton, R. (2001) *The Extent, Causes and Implications of Skills Deficiencies – Engineering Sector: Case Studies,* National Skills Task Force / DfES Publications

decline from 651,000 in 2010 to 543,000 in 2020. Given that there are likely to be replacement demands of around 245,000 over the same period, there will be a net requirement for an additional 136,000 people to work in these jobs. It also needs to be borne in mind that apprentices may fill some associate professional jobs, too.

Table 3: Employment and replacement demands by occupation in manufacturing, 2000 to 2020

	Employment level (000s)			Change in employment, 2010 to 2020 (000s)		
	2000	**2010**	**2020**	**Net change**	**Replacement demands**	**Total requirement**
1. Managers etc.	337	267	297	30	111	141
2. Professionals	432	319	349	30	113	143
3. Associate professionals	462	288	305	17	104	121
4. Administrative and secretarial	416	191	173	-19	85	66
5. Skilled trades occupations	1437	651	543	-108	245	136
6. Caring, leisure and other service	30	20	25	5	8	13
7. Sales and customer service	100	76	74	-3	25	22
8. Process, plant and machine operatives	1338	503	389	-114	199	85
9. Elementary occupations	393	202	193	-9	75	66
Total	4944	2518	2347	-170	965	795
	Shares of total employment (column %)			**Change 2010 to 2020 (%)**		
	2000	**2010**	**2020**	**Net change**	**Replacement demands**	**Total requirement**
1. Managers, etc.	7	11	13	11	42	53
2. Professionals	9	13	15	9	35	45
3. Associate professionals	9	11	13	6	36	42
4. Administrative and secretarial	8	8	7	-10	45	35
5. Skilled trades occupations	29	26	23	-17	38	21
6. Caring, leisure and other service	1	1	1	23	41	64
7. Sales and customer service	2	3	3	-4	33	29
8. Process, plant and machine operatives	27	20	17	-23	40	17
9. Elementary occupations	8	8	8	-4	37	33
Total	100	100	100	-7	38	32

Source: Working Futures database

Another way of looking at the data is to consider the projected future demand for people to work in skilled trades jobs.[22] Not all of these will be STEM-related, though it is likely that a substantial percentage will be. Although the overall number is projected to fall over the 2010 to 2020 period, relatively strong replacement demands will mean that just under one million additional skilled trades jobs will need to be filled over the period (see Table 4). Whether supply is sufficient to keep pace with demand is considered below.

Table 4: Replacement demands and net requirements for skilled trades workers, 2010 to 2020 (000s)

	Levels		2010 – 2020		
	2010	2020	Net change	Replacement demands	Total requirement
All Industries	3006	2784	-222	1173	952
Primary sector and utilities	218	207	-12	106	95
Manufacturing	651	543	-108	245	136
Construction	972	1031	59	364	424
Trade, accommodation and transport	684	570	-114	260	146
Business and other services	379	363	-15	154	139
Non-marketed services	102	70	-32	44	12

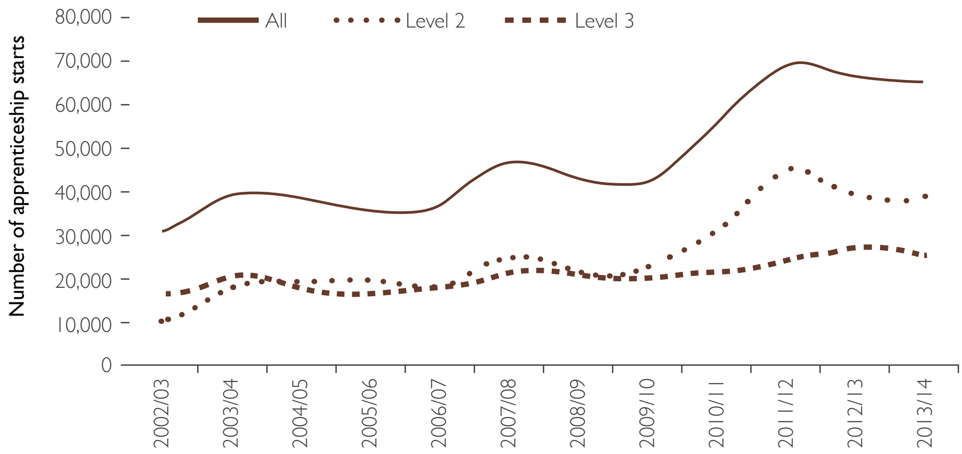
Source: Working Futures 4

2.4 THE SUPPLY OF INTERMEDIATE-LEVEL STEM SKILLS THROUGH APPRENTICESHIPS

The data reveal that over recent years there has been a substantial increase in the number of Apprenticeships in engineering and manufacturing technologies. Figure 2 shows that, over the past decade, the number of Apprenticeship starts in this subject has doubled from around 30,000 in 2002/3 to 60,000 in 2013/14. The growth is reflected in the number of starts at Levels 2 and 3, though the growth at Level 2, where starts have tripled, has been much stronger than for Level 3, which has grown by around two-thirds. The number of starts amongst those aged under 19 years of age at the start of their Apprenticeship has been more or less stable over time, with growth taking place more amongst those aged 19-24 years, and those aged over 25 years (see Figure 3). In fact, as Figure 3 shows, a large share of the growth over recent years has been accounted for by those aged over 25 years at the start of their training. In 2002/3 no apprentices were aged over 25 years, by 2008/9 this age group accounted for 10% of all starts, and by 2012/13 this had risen to 31%.

22 This occupational group includes jobs such as Metal Machining Setters and Setter Operators, Tool Makers, Precision Instrument Makers and Air Conditioning Engineers.

Figure 2: Apprenticeship starts under engineering and manufacturing frameworks



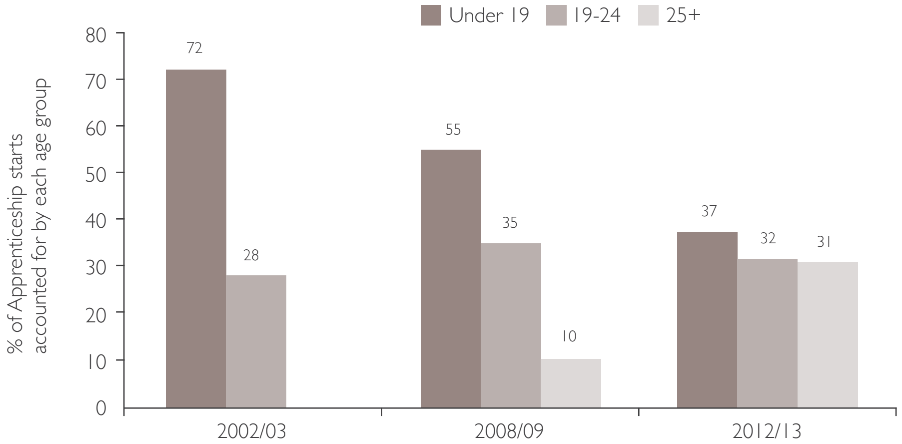
Source: FE Statistical First Release

A criticism of the growth in Apprenticeships has been that the growth in starts has been accounted for by existing employees, who are relatively old, being placed on Apprenticeship programmes. Whilst Apprenticeships have a particularly important role to play as a form of continuing vocational education and training,[23] the concern has been that many of those aged over 25 years, who are existing employees, are having existing skills accredited rather than new skills supplied. Figure 2 shows that Apprenticeship starts under engineering and manufacturing frameworks have also increasingly been accounted for by those aged over 25 years, but this is less so than across all frameworks. It is also known that, under engineering and manufacturing frameworks, the percentage of starts accounted for by existing employees (at 27% of all Apprenticeship starts) is lower than across all frameworks (48%).[24] At the time of writing, public policy appears to be in two minds about the value of Apprenticeships for those in the 25+ age group. In general, public funding is no longer available for this older group, but there may be specific local initiatives that provide some support. The fact remains that if the 25+ age group is excluded from the statistics on Apprenticeships, then the increase in starts looks less impressive but would still reveal growth.

23 Vogler-Ludwig, K., Stock, L., Giernalczyk, H., and Hogarth, T. (2011) *International Approaches to the Development of Intermediate-level Skills and Apprenticeships: Synthesis Report*, UK Commission for Employment and Skills, Wath-upon-Dearne

24 Calahan, M. and Johnson, C. (2014) *Apprenticeship Evaluation: Employers*. BIS Research Paper No.204

Figure 3: Apprenticeship starts under engineering and manufacturing frameworks, by age of apprentices at the commencement of their training



Source: FE Statistical First Release

Engineering and manufacturing frameworks are not the only ones that constitute STEM Apprenticeships. There are others too, though they often have relatively small numbers of apprentices.[25] By using Engineering and manufacturing frameworks as a proxy for STEM Apprenticeships, an indication is provided of demand for, and supply of, STEM skills germane to the Apprenticeship debate. The key question is whether supply is keeping pace with demand. The evidence here is mixed. On the one hand there is evidence that employers are able to meet their demand for intermediate-level skills via Apprenticeships, but this has been described as being on a just-in-time basis.[26] Employers are also able to meet their expected demand for STEM skills, by investing in Apprenticeships to meet projected demand in three to four years. Should demand grow for an organisation's goods in the meantime, there is little excess supply of apprentices which could meet that demand. On the other hand there is statistical evidence that, where skill shortages exist, they tend to be concentrated in sectors and occupations most associated with STEM skills.[27] In the economy as whole, 13% of all hard-to-fill vacancies are found in skilled trades occupations, but in the manufacturing sector they account for 31% of hard-to-fill vacancies (2013). Similarly, annual wage growth is relatively high in selected skilled trade occupations, which indicates that employers may be responding to recruitment problems by raising wages, though there are likely to be other reasons as well. There is also the possibility that persistent shortages lead employers to stop recruiting by no longer continuing to carry out certain types of work, or subcontracting the work elsewhere, so persistent skill shortages ultimately drive down the overall level of skill demand.

So the question becomes one of understanding how Apprenticeships may fill the gap. This is a complex issue given that employer demand for apprentices has, historically, been low when compared with other countries. It is worth considering how policy in England has sought to address this issue.

25 Royal Academy of Engineering (2012). *FE STEM Data Project report: November 2012.* London: Royal Academy of Engineering.

26 McCaig C., Hogarth T., Gambin L. and Clague L. (2014) *Research into the need for and capacity to deliver STEM-related apprenticeship provision in England,* BIS Research Paper No. 171

27 Winterbotham M., Vivian D., Shury J. and Davies B. (2014). *Employers Skills Survey 2013.* UK Commission for Employment and Skills Evidence, Report 81

2.5 APPRENTICESHIP POLICY TO STIMULATE EMPLOYER DEMAND FOR APPRENTICES

Persuading employers to invest in Apprenticeships has proved to be an enduring problem facing policy-makers in England. During the 1970s, the Manpower Services Commission (MSC) became increasingly frustrated at the relatively small share of the school-leaving cohort that entered an Apprenticeship.[28] So frustrated in fact that the MSC increasingly sought to introduce alternative forms of vocational education and training (VET) to Apprenticeship, whereby students could obtain vocational qualifications by studying at their local further education (FE) college. It was not only the relatively small share of employers and school-leavers participating in Apprenticeships that concerned policy makers at the time. Because Apprenticeships were time-served, employers would prolong the duration of the formal training period so as to avoid placing the apprentices on adult rates of pay.

Despite the concerns of policy makers about the operation of the system in England, the intrinsic value attached to the ideal of Apprenticeship training was largely unaffected. In part, this stemmed from its persistence as a means of training. If apprenticeships could survive through the centuries from the medieval period and well into the twentieth century, then this must say something about its merits as a form of skills development. At the same time, there was a belief that the relatively strong international competitiveness of countries such as Germany, Austria, and Switzerland owed much to the mass participation, by employers and young people, in their respective Apprenticeship programmes. So the ideal of Apprenticeships lived on, even if in practice it proved difficult to make it work in the UK.

Fast forward around twenty years from the 1970s, and Apprenticeships were firmly back on the agenda of policy-makers in England. Worried about the continued poor supply of young people skilled at an intermediate level, and relatively high levels of youth unemployment which had not been sufficiently addressed by programmes such as the Youth Opportunities Programme, the Government of the day introduced Modern Apprenticeships in 1994. By making completion of Apprenticeships competence-based, where competence was judged by an external assessor rather than the employer, the problems associated with the old time-served element were neatly side-stepped. And with the State meeting a large share of the overall cost of the apprentice's training, there was a strong financial incentive for the employer to participate. The State was effectively providing employers with a substantial training subsidy in order to offset a market failure.

The initial evaluations of publicly funded Apprenticeships were encouraging.[29] They demonstrated that around 20% of employers participating in Apprenticeships did so as a direct consequence of the programme; and even where employers would have trained apprentices in any case, the programme had brought about an increase of around 10% in the number of apprentices they had taken on. But there were continuing frustrations with the publicly-funded Apprenticeship programme at the lack of participation and the quality of some of the training. This was made manifest in 2001 by the Cassels report[30] which commented that, in the intervening

28 Haxby, P. and Parkes, D. (1989). "Apprenticeship in the United Kingdom: From ITBs to YTS". *European Journal of Education,* Vol. 24, No. 2, pp. 167-181

29 Hasluck, C., Hogarth, T., Maguire, M. and Pitcher, J. (1997) The Effect of Modern Apprenticeships on Employers' Training Practices and the Availability of NVQ Level 3 Training, Department for Education and Employment Research Report; Riley, R. and Metcalf, H. (2003) Modern Apprenticeship Employers: Evaluation Study, Department for Education and Skills, Research Report RR417.

30 Cassels, J. (2001). Modern apprenticeships : the way to work : the report of the Modern Apprenticeship Advisory Committee. Suffolk: Department for Education and Skills,

years since the establishment of the publicly-funded programme, the Modern Apprenticeship brand had become tarnished.

From a promising start, Modern Apprenticeships had, given Cassel's findings, ultimately failed to provide employers and apprentices with high quality training which would improve the former's productivity performance and the latter's employment and wage prospects. This stemmed from too much emphasis being placed on achieving a given quantity of Apprenticeship starts that resulted, too often, in Apprenticeships being associated with the accreditation of existing skills rather than the production of new ones. Moreover, many Apprenticeships were provided at a relatively low skill level. The level of conceptual difficulty was pitched at a level equivalent to that which might be expected at the end compulsory schooling. In other countries, such as Germany, the conceptual level of difficulty was much nearer to that associated with completing post-compulsory upper-secondary level education.

The problem with publicly funded Apprenticeships became increasingly articulated with respect to the dominance of the supply-side. Training providers – including private sector providers and FE colleges – provided a training offer to employers and apprentices largely dictated by the Apprenticeship funding formula. The training market was expected to meet employer demand, rather than employers being persuaded to take on apprentices because it would not cost them much, either directly (paying for training courses) or indirectly (foregone output when workers were training). This was because much of the training could be quickly delivered on the job. This may be an over-statement, but it captures the principal worry about a training system that was being driven too much by the supply-side. Of course, there was a reason why the system was so supply-side oriented, and this was the longstanding anxiety that an overly demand-side led system may not produce the skills the country needs in sufficient volume. Policy-makers had the same anxiety in the 1970s and again in the early 1990s when the publicly-funded Apprenticeship programme was first launched.

In 2012, the Richard Review of Apprenticeships outlined a radical reform of publicly-funded Apprenticeships. Richard, in essence, suggested a trade-off between more employer control over the structure, duration and content of Apprenticeships, in return for employers meeting a greater share of the overall cost of delivering the Apprenticeship. This would not necessarily result in the employer paying more, compared with the existing system. Whilst the employer might meet a higher share of the overall cost, the overall cost could be lower as a result of the employer possessing more control over the Apprenticeship. Since public funding would be routed through employers, there would be scope for employers to obtain better value for money from any provider they selected to deliver their training. Under this scenario, training providers' costs could be driven down. Employers' costs too could be reduced if they were able to deliver training to their apprentices more efficiently.

It is implicit in the funding model underlying Richard's recommendations that employers invest in Apprenticeships because they obtain a benefit from doing so and, accordingly, should be expected to meet more of the cost of that investment. And the more they are expected to meet the overall cost of an Apprenticeship, up to some optimum point, the more likely they are to ensure that they obtain a return on that investment.[31] Under the old funding system, some employers met little – if any, in some sectors – of the overall cost of the Apprenticeship so they had commensurately little interest in ensuring that they obtained a return on the training investment. Whilst this may have been true of Apprenticeships at Level 2, it was always much less true of those at Level 3, where the employer had incurred a substantial net cost at the end of the training period. It was also much less of an issue in relation to STEM Apprenticeships that were widely regarded as being of high quality, with substantial employer engagement in their design and structure.

2.6 CONCLUSION

For high quality and relatively high cost Apprenticeships in sectors such as engineering, the problem remains of how to persuade more employers to invest in this form of training. Employer-routed funding may well improve the husbandry of apprentices by employers looking to protect their investment; however this was always the case in sectors such as engineering, where the employer could face a net cost by the end of the Apprenticeship of around £40,000 for each apprentice trained. Whether or not having more control over the content, structure and duration of training would result in any cost savings is a moot point, given that these employers have been, over many years, successful in ensuring that Apprenticeship training is tailored to the employer's and the wider industry's needs. Their continued investment in Apprenticeships is predicated on it delivering the skills they need. The principal issue here is how to increase the population of employers that recurrently invest in Apprenticeships.

31 Hogarth T, Adams L, Gambin L, Garnett E, Winterbotham M (2014) *Employer-Routed Funding: Employer Responses to Funding Reform*, BIS Research Paper No. 161

SECTION 3 THE COSTS AND BENEFITS OF STEM-RELATED APPRENTICESHIPS TO EMPLOYERS: EVIDENCE FROM ENGLAND

3.1 INTRODUCTION

This section looks at the costs and benefits that accrue to employers who train apprentices under STEM-related Apprenticeships. It starts by considering the economics of training from a theoretical perspective, and considers how employers have been able to justify and recoup the relatively substantial investments they make in STEM Apprenticeships. In particular, it considers the ways in which they have been able to accrue a sizeable net cost by the end of the training period, but have been able to retain the services of their apprentices post-training, even though they are, from a purely theoretical perspective, at risk of losing their former apprentices to non-training companies which are able to pay higher wages because they are not carrying the costs associated with training apprentices. This is explained with reference to, amongst other things, the bond or lock the Apprenticeship firm is able to develop with its apprentices. This ensures that apprentices the employer has trained stay with the company post-training.

3.2 THE ECONOMICS OF APPRENTICESHIP TRAINING

As a starting point it is worth considering the question: who should pay for Apprenticeship training? Benefits accrue to the employer from the productivity gains they secure from the training they provide, and benefits accrue to the ex-apprentice from having a higher likelihood of being in employment in relatively well-paid jobs. Additionally, the State benefits from increases in tax revenues and reduced spending on welfare payments. In practice, it is difficult to decide what share of the training costs should be borne by all three parties. Because of the risk of market failure, the State has tended to meet a substantial share of the overall cost of Apprenticeship training, by wholly funding those who deliver training to participating employers. This issue is returned to later in the section on policy developments aiming to increase participation in Apprenticeships.

Human capital theory, though it has its critics, provides a useful starting point for understanding the Apprenticeship training which employers will be willing to fund (assuming that employers are rational economic agents, looking to maximise their profits under perfectly competitive conditions).[32] Under the human capital model, an employer will only be willing to fund training which is specific to the firm. In other words, the employer will only fund that training which is not transferable to other firms, and consequently, it is able to appropriate all the benefits of the training it provides. It will not fund general training which is transferable to other firms, because non-training firms will be able to appropriate some, if not all, of the benefits of that training, leaving the training firm with a net cost. As Lazear has noted, in practice it is difficult to identify organisation-specific skills, and most jobs are bundles of general skills.[33] This would seem to place the responsibility for funding training on the individual, rather than the employer, who tends to face a

32 Becker, G. (1964). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education.* Chicago: The University of Chicago Press.

33 Lazear, E. P. (2009) Firm-Specific Human Capital: A Skill-Weights Approach *Journal of Political Economy* Vol. 117, No. 5 (October 2009), pp. 914-940

number of financial barriers to paying. This means that the State has to step in to make the investment on their behalf. This issue is returned to later.

The human capital model also suggests that employers would be unwilling to carry a deficit at the end of the training period, because they would not have a guarantee that they would be able either to retain the skilled employee or to recoup the costs of their training.

The evidence presented below demonstrates that employers in England face a relatively high net cost at the end of training someone to the completion of a STEM-related Apprenticeship at Level 3. They are willing to take the risk on their investment, because they see little alternative to investing in Apprenticeships if they are to secure the skills they need; and they believe they have in place mechanisms to ensure that they can retain their apprentices, once trained, without resorting to raising wages to uncompetitive levels. While this may explain why the existing stock of employers provides STEM Apprenticeships, it provides few clues as to how those employers not investing in STEM Apprenticeships could be persuaded to do so for the benefit of their organisations.

Increasing employer participation in Apprenticeships has become focussed around:

1. providing employers with greater ownership of the structure and content of this form of training (*c.f.* Trailblazers);
2. making it a relatively cost-effective investment (e.g. in some sectors, employers and training providers have been able to structure the Apprenticeship so that the overall costs of the training are met over the training period).

This needs to be seen in the context of current Government policy, which is oriented towards the beneficiaries of Apprenticeship training meeting a fairer share (however defined) of the overall costs than at present. This potentially places pressure on employers to offset any additional costs they would have to absorb if they were expected to meet a higher overall share of an Apprenticeship's total cost. Potentially a number of options are open to employers including:

- reducing apprentices' wages;
- restructuring the Apprenticeship such that:
  - it is completed over a shorter time, thereby reducing the overall net cost at the end of training period;
  - the productive contribution of the apprentice whilst in training is increased;
- obtaining greater value for money from training providers.

The options listed above could reduce the overall cost to the employer, compared with the situation at present, if they allowed training of the same quality to be delivered more efficiently. So employers could be meeting a higher share of the costs of Apprenticeship, while the overall cost to them is lower. This could potentially make Apprenticeships more attractive to employers currently put off by the costs they are likely to face in delivering a STEM Apprenticeship. However, depending on whether or not the cost figures are favourable, the employer could choose to withdraw from publicly-funded Apprenticeships and invest in a comparable form of training which is, for instance, not accredited or accredited solely by the training employer.

3.3 THE COST OF A STEM-RELATED APPRENTICESHIP TO THE EMPLOYER

The IER Net Costs and Benefits of Training to Employers series of studies provide an estimate of the net cost to the employer of training a single apprentice to completion of an Apprenticeship.[34] If a Level 3 Apprenticeship in Engineering is taken to approximate the costs to the employer of training under a STEM Apprenticeship, the evidence suggests that the cost will be around £40,000 (see Table 5). This covers the cost of a typical three-and-a-half year Apprenticeship which encompasses a Level 2 qualification along the way to completing the Level 3 Apprenticeship. It is an Apprenticeship which typically requires apprentices to spend relatively long periods engaged in off-the-job training, especially in the first year when the apprentice may well spend extended periods on block-release at local FE college. This model of training apprentices would appear to be long-established. It is not necessarily the Apprenticeship frameworks that cause training to be structured in this way. Rather it reflects the training tradition long established in the sector.

Table 5: The net costs of Apprenticeship training in selected sectors

	Apprenticeship			Workplace learning
Sector	**Level 2**	**Level 3**	**Level 2 and 3 combined**	**Level 2**
Engineering			£39,600	
Construction			£26,000	
Retailing	£3,000			£1,650
Hospitality	£5,050			£1,950
Transport and Logistics	£4,550			£2,500
Financial Services	£7,250	£11,400		
Business Administration	£4,550			
Social Care	£3,800			£1,250 (£1,200 for Level 3)

Note: Data have been rounded to nearest £50

Source: IER / IFF Employer Net Benefit of Training Study 2012

The £40,000 figure represents the entire cost to the employer at the end of training period, and includes all the wage and non-wage costs associated with employing an apprentice plus supervisory costs, minus the value of the output produced by the apprentice over the course of his or her formal training period. As can be seen in Table 5, the cost of a Level 3 Apprenticeship in engineering is substantially higher than that in other sectors.

Table 6 provides a detailed breakdown of the costs and benefits to the employer of training a single apprentice to the completion of an engineering Apprenticeship. Table 6 is based purely on the costs borne by the employer. Table 7 provides the overall cost including the funding provided by Government.

34 Hogarth, T., Gambin, L., Winterbotham, M., Baldauf, B., Briscoe, G., Gunstone, B., Hasluck, C., Koerbitz, C. and Taylor, C. (2012) *Employer Investment in Apprenticeships and Workplace Learning: The Fifth Net Benefits of Training to Employers Study,* BIS Research Paper No. 67

Table 6: Employers' costs and benefits of Apprenticeship training in engineering

	Year 1	Year 2	Year 3	Year 3.5	Total
Background Information					
Apprentice salary (£ p.a.)	£11,423	£13,369	£15,492	£7,975	£48,259
Salary of fully experienced worker + NI (p.a.)	£24,831	£24,831	£24,831	£12,415	£86,908
Trainee productivity (% of skilled workers tasks undertaken by trainee)	28%	54%	69%	78%	
Supervision (per trainee)					
% Training manager's time spent training (in each year)	7%	7%	7%	7%	
% Line manager's time spent training (in each year)	9%	6%	4%	1%	
% Supervisor's time spent training (in each year)	15%	11%	10%	2%	
Training manager's salary (£ p.a.)	£41,750				
Line manager's salary (£ p.a.)	£29,600				
Supervisor's salary (£ p.a.)	£25,800				
Total labour costs of supervision (incl employer NI contributions)	£9,515	£7,739	£6,642	£1,867	£25,764
Total training costs per apprentice or trainee (£)					
Costs of recruiting the apprentice	£750	0	0	0	£750
Course fees	£558	£558	£536	£1,081*	£2,734
Supervision costs	£9,515	£7,739	£6,642	£1,867	£25,764
Administrative costs / Other costs	£500	£389	£389	£563	£1,840
Total cost	£22,747	£22,055	£23,060	£11,486	£79,348
Total cost / benefit to the employer per trainee					
Trainee product	£6,299	£12,347	£15,622	£8,787	£43,055
Other income (please specify)					
Total benefit per apprentice	£6,299	£12,347	£15,622	£8,787	£43,055
Net cost per apprentice	£16,448	£9,709	£7,438	£2,699	£36,292
Net cost including drop out**	£18,179	£10,591	£8,114	£2,699	£39,582

*Includes additional training required by employers which was not part of the publicly-funded Apprenticeship.

**Drop-out is determined by the total number of apprentices who complete training, as a percentage of those who commenced it, adjusted for when the drop-out takes place.

Source: IER / IFF Employer Net Benefit of Training Study 2012

Table 7 below shows the extent to which, before the introduction of employer-routed funding, the overall costs of the Apprenticeship were shared between employer and the State. The State's contribution is that of directly paying the training provider to deliver certain elements of the Apprenticeship framework. The table shows that, in the case of engineering, the employer tends to meet around two-thirds of the overall cost for apprentices aged 16-18 at the start of their training, and around four-fifths where the apprentices are aged 19-24 years old at the start.

Table 7: Estimate of the total cost of training met by the employer

Age of apprentice at start	Employer costs	Costs of Apprenticeship met by State	Total cost of Apprenticeship (a + b)	Share of costs met directly by employer (%)	Share of costs met directly by the State (%)
16-18 year olds	£39,582	£23,240 (£14,403 for Level 3; £8,837 for Level 2)	£62,822	63	37
19-24 year olds	£39,582	£10,177	£49,759	79	20

Source: IER / IFF Employer Net Benefit of Training Study 2012

Using a method for identifying how long it would take an employer to recoup the costs of training an apprentice, it is estimated that an employer in the engineering sector accruing an average net cost of £40,000 could recoup that investment in around three and a half years after the end of training (see Table 8).[35] This is relatively long compared with most other Apprenticeships.

Table 8: Payback periods by sector

Sector	Apprenticeship Level	Payback period
Engineering	Level 3 (including obtaining the Level 2 qualification)	3 years, 7 months
Construction	Level 2+3	2 years, 3 months
Retail	Level 2	2 years, 3 months
Hospitality	Level 2	10 months
Transport	Level 2 (mechanic)	6 months
Financial Services	Level 3	2 years, 6 months
Business Administration	Level 2	9 months
Social Care	Level 2	3 years, 3 months

Source: IER / IFF Employer Net Benefit of Training Study 2012

35 Gambin, L., Hasluck, C. and Hogarth, T. (2010): 'Recouping the costs of apprenticeship training: employer case study evidence from England', *Empirical Research in Vocational Education and Training*, Vol. 2, No. 2, pp. 127-146

3.4 VARIATIONS IN EMPLOYERS' NET COSTS

The data provided in Table 6 represents an average derived from detailed case studies of eleven organisations delivering STEM (Engineering) Apprenticeships. Variation in the net costs was observed. Table 9 on the following page provides estimates for the minimum and maximum costs observed across the employer case studies. It reveals that costs can vary substantially, depending upon the productivity of apprentices, the cost of supervision, and the wages paid to apprentices: from a net cost of £64,000 in the highest cost example (an outlier in the data), to £29,000 in the low cost example.

The extent to which employers can vary their costs is taken up again in Section 4. This explores how employers may be able to better manage the risk attached to making an investment in an intermediate-level STEM Apprenticeship.

Table 9: Examples of relatively high cost and low cost Apprenticeships

	High cost				Low cost			
	Year 1	Year 2	Year 3	Total	Year 1	Year 2	Year 3	Total
Background information								
Drop-out rate (%)	50%	0%	0%		0%	0%	0%	
Apprentice salary (£ p.a.)	£12,708	£16,520	£20,332		£7,800	£10,400	£13,000	
Salary of fully experienced worker + NI (£ p.a.)	£27,947	£27,947	£27,947		£19,144	£19,144	£19,144	
Apprentice productivity	25%	45%	80%		0%	50%	75%	
Supervision (per trainee)								
% of training manager's time spent training (in each year)	2%	2%	2%		0%	0%	0%	
% of line manager's time spent training (in each year)	6%	5%	4%		0%	0%	0%	
% of supervisor's time spent training (in each year)	13%	8%	8%		15%	15%	15%	
Training manager's salary (£ p.a.)	£40,000	£40,000	£40,000					
Line manager's salary (£ p.a.)	£38,000	£38,000	£38,000					
Supervisor's salary (£ p.a.)	£30,000	£30,000	£30,000		£23,400	£23,400	£23,400	
Total labour costs of supervision (including NI)	£6,925	£4,950	£4,475	£16,350	£3,510	£3,510	£3,510	£10,530
Total training costs per apprentice (£)								
Costs of recruiting the apprentice	£1,250				£750			
Course fees					£550			£550
Supervision costs	£7,678	£4,955	£4,480	£17,113	£3,848	£3,513	£3,513	£10,875
Apprentice salaries (including employer NI)	£13,486	£17,824	£22,162	£53,471	£7,900	£10,859	£13,818	£32,578
Total cost	£22,414	£22,779	£26,642	£71,835	£13,048	£14,373	£17,331	£44,753
Total cost / benefit to the employer per Apprentice								
Apprentice product	£3,177	£7,434	£16,266	£26,877	£0	£5,200	£9,750	£14,950
Total benefit per Apprentice	£3,177	£7,434	£16,266	£26,877	£0	£5,200	£9,750	£14,950
Net cost per Apprentice	£19,237	£15,345	£10,376	£44,958	£13,048	£9,173	£7,581	£29,803
Net cost including drop-out	£38,474	£15,345	£10,376	£64,195	£13,048	£9,173	£7,581	£29,803

Source: IER / IFF Employer Net Benefit of Training Study 2012

3.5 THE EMPLOYER RATIONALE FOR INVESTING IN STEM APPRENTICESHIPS

If employers are willing to make a £40,000 investment, it is worth considering their rationale for doing so, especially given the human capital argument outlined at the start of this section. The overall evidence, from the various studies IER has undertaken on Apprenticeships, reveals that employers in the engineering sector invest in this form of training because it effectively and efficiently meets their demand for skilled workers. This view is endorsed by employer survey evidence, which demonstrates that employers offering Apprenticeships under engineering / electro-technical frameworks are likely to say that Apprenticeships are the most relevant training to address the needs of their business (32% of employers offering this type of Apprenticeship) and are the required form of training in their sector (22%).[36] Employer case study evidence provides a more detailed assessment of why employers invest in engineering Apprenticeships.[37] These reasons include:

- improving skills supply:
  - meeting current and future skill demand;
  - improving the quality of recruits capable of acquiring the skills the business needs;

  provision of relatively high quality training;
- minimising the risk attached to investing in training, so that employers obtain the skills they want and are able to appropriate the benefits of the training they provided:
  - a preference for developing skills in-house (because in this way there is a degree of control over the delivery and content of training);
  - a means of improving labour retention (a perception that employees are more likely to stay with the employer which trained them);
  - a relatively cost-effective means of training (the costs associated with training through Apprenticeships are considered to be lower than those associated with any alternatives).
- developing a cadre of staff from which to select future technicians and managers.

In addition, several employers also said it was important for their organisation to offer training opportunities, especially to young people, in the areas in which they were located. The panel below provides a typical example of the employer's rationale for investing in STEM Apprenticeships.

36 Colohan, M. and Johnson, C. (2014) *op cit*

37 Hogarth et al. (2014) *op cit;* Hogarth et al. (2012) *op cit*

ENGINEERING EMPLOYER CASE STUDY: MEDIUM-SIZED ENGINEERING COMPANY

The company has recurrently offered Apprenticeships since 1967. There are currently 57 employees, 19 of whom are ex-apprentices. The company usually takes on one apprentice a year under the engineering framework, starting at Level 2 and leading to Level 3. When asked to identify the most valuable elements of Apprenticeships to the business, the company representative considered the Apprenticeship to be:

- a training programme which delivers the skills the business needs;
- a rigorous and structured training programme (the Apprenticeship provides a good quality training programme for people with little or no skills or experience; and there were no trained people just 'out there', waiting to be 'picked off the shelf');
- a good springboard on which to develop further skills;
- a flexible programme of training which allows work and training to be readily accommodated;
- reduces labour turnover (he felt that the training provided stability within the business, although this was not a major reason for providing Apprenticeships);
- a cost-effective form of training, because the Apprenticeship was the only way to get the people the business needed;
- a way of doing something positive locally (this was strongly endorsed).

This company also liked apprentices who it knew had a certain amount of parental support, which was crucial: both the parents and the apprentices were asked to sign an 'old-fashioned Apprenticeship form', similar to a contract, to make them aware of their responsibilities.

Source: Hogarth et al. *(2014)*

In general, employers invested in engineering / technical Apprenticeships because they had done so for a relatively long period of time, and this form of training had sufficiently met their demand for skills. Employers would also point out that there were no alternatives readily available which would allow them to train people in engineering skills. Although employers were not always aware of the overall cost of training an apprentice, they realised that the salary costs alone resulted in a substantial expense accruing to the company by the end of the formal training period. Engineering employers were confident that they could retain the services of the apprentice once they had completed their training because:

- the Apprenticeship allowed the employer to develop a bond with the apprentices over their training period; this was sometimes referred to as being able to steep the apprentices in the values of the company;
- there were opportunities for continued career development and training, depending upon the capabilities of the ex-apprentice;
- the Apprenticeship often developed specialist skills, which while potentially transferable, were not always so in practice when the employer was situated in a niche market.

3.6 CONCLUSION

The evidence provided above indicates the way in which employers have been able to justify their relatively substantial investments in Apprenticeship training. It is notable that many are carrying over a substantial cost into the post-training period, but are able to retain the former apprentice by various means which essentially provide a bond or lock between employer and the former apprentice. This takes the form of providing skill mixes that are relatively unique and thereby reduce the potentially transferability of skills that, additionally, provide the base for further training and career development opportunities. There is also a relationship between employer and ex-apprentice based on shared values, which again helps reduce the risk of the apprentice leaving to work elsewhere.

SECTION 4 STIMULATING EMPLOYER DEMAND FOR STEM APPRENTICESHIPS – APPROACHES TO MANAGING THE TRAINING INVESTMENT RISK

4.1 INTRODUCTION

The previous section has provided an outline of the economic rationales which employers use to justify sizeable investments in STEM-related Apprenticeships. It is useful to understand how the current demand from employers for STEM apprentices could be expanded. Research on why employers do not invest in STEM Apprenticeships is relatively scarce. Where data exists, it relates to Apprenticeships overall and suggests that non-participation is driven by:[38]

1. a lack of business demand;
2. a lack of awareness of Apprenticeships;
3. dissatisfaction with Apprenticeships in the past;
4. financial issues / concerns about being able to deliver an Apprenticeship.

It is worth taking a step back to consider the wider context, and how the risk associated with investing in an Apprenticeship is determined by the wider labour market. There are valuable lessons to be learnt from research undertaken on the apprenticeship systems in Germany and Switzerland respectively.[39] The former is a relatively costly system from the employer perspective, but one which allows the employer to recoup the costs of the investment in Apprenticeships over the post-training period. The latter is an example of a system where the employer faces more of a risk in later recouping their investment, and this has resulted in employers looking to reduce their overall net cost of training. Arguably, the quality of outputs from both systems is more or less the same – highly trained and skilled intermediate-level workers.

4.2 LESSONS FROM GERMANY AND SWITZERLAND

Germany has been able to deliver high-cost, high-quality Apprenticeships because the operation of its labour market has allowed firms investing in Apprenticeships to appropriate the returns of that investment. This has been explained largely with reference to the labour market in Germany being less flexible than in, for instance, Switzerland or the UK.[40] Accordingly, non-training companies have less scope to offer higher wages to attract skilled workers from companies that do train, so skilled employees have less incentive to change employers. Plans to make the labour market more flexible in Germany raised fears that this could potentially damage the operation of the Apprenticeship system.[41]

38 Cambridge Policy Consultants / Mori (2008). *Research into Increasing Apprenticeships. Report to the Learning and Skills Council.* Coventry: Learning and Skills Council

39 This draws upon the substantial and impressive research programme undertaken by Professor Stefan Wolter and his colleagues.

40 Wolter, S.C. and Mühlemann, S. (2006) 'Why Some Firms Train and Others Do Not'. *German Economic Review* 7(3); Acemoglu, D. and Piscke, J-S. (1999) 'Beyond Becker: Training in Imperfect Labour Markets'. *Economic Journal*, Vol. 109

41 Jansen, A; Strupler Leiser, M.; Wenzelmann, F.; and Wolter, S.C. (2012) *The Effect of Labor Market Deregulation on Training Behavior and Quality: the German Labor Market Reforms as a Natural Experiment.* Universities of Zurich and Bern Leading House Working Paper No.83; Mühlemann, S.; Pfeifer, H.; Walden, G.; Wenzelmann, F.; Wolter, S.C. (2010) 'The Financing of Apprenticeship Training in the Light of Labour Market Regulations', *Labour Economics*, 17(5)

In both Germany and Switzerland, the Apprenticeship system is highly regarded by the social partners as delivering economically valuable skills to employers and individuals alike. In Switzerland however, a country with a more flexible labour market than Germany, the net cost to the employer is much lower. The implication is simple enough: first, Apprenticeships in Switzerland are delivered more efficiently than in Germany; and second, if Germany wants to create a more flexible labour market, then its Apprenticeship system may have to change so that it has more in common with that of Switzerland.

Cost comparisons between countries are difficult to make because their methods of calculation vary so much. But there is a general pattern to the data showing that the net cost of training an apprentice in Germany is higher than in Switzerland.[42] The principal explanation is that employers in Switzerland need to recoup much of the overall cost of training an apprentice over the formal training period, since they have no guarantee that they will be able to retain the services of their apprentices once they have completed their training.[43] They achieve this by ensuring that, compared with Germany, a relatively high proportion of the apprentices' time in the workplace is spent engaged in productive activity. The employer in Switzerland is not always able to fully recoup the costs of training their apprentices over the formal training period, but any residual net cost is likely to be relatively low compared with their German counterparts.[44] Hence the risk faced by the employer in investing in Apprenticeships in a flexible labour market is reduced. Where they face a net cost at the end of the Apprenticeship, any return will be obtained only if they have in place the workplace policies and practices that will retain the apprentice post-completion.[45]

Where cost comparisons have been made between countries, the UK Apprenticeship system stands out as being one where the employer bears relatively high net costs.[46] Care needs to be taken in making these comparisons, but there is prima facie evidence that the UK may have achieved the worst of both worlds in some sectors: a relatively high cost system in a relatively flexible labour market. If so, then this would suggest that employers considering investing in Apprenticeships would face higher risks than their counterparts in Switzerland or Germany. It then follows that this would dampen the employer's likelihood of investing in this form of training. Of course, there are other reasons why employers may be reluctant to invest in Apprenticeship training, not least of which is that they may have relatively little demand for the types of skill that an Apprenticeship would produce for them.[47]

42 Dionisius, R., Mühlemann, S., Pfeifer, H., Walden, G., Wenzelmann, F., and Wolter, S.C. (2009) 'Cost and Benefit of Apprenticeship Training: A Comparison of Germany and Switzerland'. *Applied Economics Quarterly*, 2009, 55(1), 7-36

43 Wolter, S.C.and Mühlemann, S. (2013) *Return to Investments Systems in Enterprises: Evidence from cost-benefit analyses.* European Expert Network on Economics Education Analytical Report No.16

44 Zwick, T. (2007) *Apprenticeships Training in Germany: Investment or productivity driven?* IZA Discussion Paper 07-023

45 Mohrenweiser, J. and Zwick, T. (2008) *Why Do Firms Train Apprentices? The Net Cost Puzzle Reconsidered.* IZA Discussion Paper 08-019

46 Vogler-Ludwig, K., Stock, L., Giernalczyk, H., and Hogarth, T. (2011) *International Approaches to the Development of Intermediate-level Skills and Apprenticeships: Synthesis Report*. UK Commission for Employment and Skills, Wath-upon-Dearne;

47 Schweri, J. and Mueller, B. (2007) Why has the share of training firms declined in Switzerland? *Zeitschrift für Arbeitsmarkt Forschung - Journal for Labour Market Research*, 2007, vol. 40, issue 2/3; Ipsos MORI (2008) Research Into Expanding Apprenticeships, Learning and Skills Council, Coventry

If the aim is to reduce the risk faced by the employer in investing in Apprenticeships, then the analyses undertaken in Germany and Switzerland suggest that at least three issues need to be addressed, including whether there is scope to:

- reduce the employer's net costs of training under Apprenticeships;
- ensure that the training employer is able to appropriate a fair share of the benefits from their investment in Apprenticeships;
- equalise the risk to all employers – training and non-training ones alike – through a training levy of some kind or through group training approaches.

These are considered below.

4.3 REDUCING THE NET COST OF STEM APPRENTICESHIPS TO THE EMPLOYER

If cost is one of the principal issues preventing employers investing in Apprenticeships, then it is worth considering how the overall costs could be reduced. Two of the main cost components are:

- apprentice wages; and
- supervisory costs.

These costs are to some extent offset by the product of the apprentice.

Table 10 below takes the observed net costs reported in Table 6 above and reformulates the estimates, assuming that the Apprenticeship system in England had some of the features of the German and Swiss systems – as outlined above – in relation to the productive contribution and wages of the apprentice. This is highly speculative, and is undertaken solely to illustrate the types of change that might be needed if the Apprenticeship system in England were to substantially reduce the net costs borne by employers.

In Switzerland, the productive contribution of the apprentice is considered to be relatively high over the entire training period, and this tends to lower the overall cost of the Apprenticeship to the employer. Taking the data from Table 6 above, and increasing the productive contribution of the apprentice by 5 and 10 percentage points in each year of the Apprenticeship, could have a substantial impact on the net costs to the employer. This could reduce the net cost to the employer from around £40,000 to somewhere between £34,000 and £37,500.

Table 10: The cost of Apprenticeships under varying assumptions

	Net cost to the employer
Observed net costs from the IER Net Costs and Benefits Study	
Current costs to the employer	£79,348
Current benefit to the employer	£43,055
Net cost to the employer (allowing for drop-out)	£39,582
Net cost estimate under various assumptions	
The productive contribution of the apprentice	
Increasing productive contribution by 10% each year	£34,886
Increasing productive contribution by 5% each year	£37,234
The wages of apprentices	
Apprentices wages set a German levels (i.e. 47% of those in England)	£11,686
Economies of scale	
Economies of scale where 3 apprentices can be supervised for the price of 1	£20,849
Economies of scale where 5 apprentices can be supervised for the price of 1	£17,102
Economies of scale where 10 apprentices can be supervised for the price of 1	£14,292
Combination of changes	
German wage levels and three supervised for the price of one	-£7,047
Reducing wages to German levels and increasing productive contribution by 10%	£6,990

Research commissioned by BIS has demonstrated that apprentice wages are relatively high compared with countries such as Germany and Switzerland (see Table 11 below). If apprentice wages were set at the same level as in Germany, for instance, then the overall net cost to the employer could, other things being equal, be substantially lower than at present. Table 6 indicated that apprentices' wages accounted for around 60% of the overall costs borne by the employer. If apprentice wage rates were the same as the average in Germany, then this would suggest that the overall net cost to the employer – as set out in Table 10 – could fall from £40,000 to around £12,000. That employers could reduce apprentice wages by around half, which is the effect of reducing wages to those on a par with German apprentices, requires a leap of faith. Employers tend to set wage rates at a level that will allow them to obtain apprentices with the requisite levels of educational attainment and other desirable attributes.[48] Reducing wages may divert would-be apprentices of the quality engineering employers want to something else, such as continuing down the academic pathway into HE.

Supervisory costs account for a significant proportion of overall costs borne by the employer. Table 6 suggests that these account for 30% of the total. With economies of scale this could be further reduced because a single supervisor may be able to supervise two or three apprentices at the same cost as supervising one. In general, the study that produced these estimates found that employers took on, at most,

48 Hogarth et al. (2012) *op cit*

one or two apprentices every year. So there may be limited opportunities to achieve such economies of scale. If it were possible to supervise three, five or ten apprentices at the same cost as for a single apprentice, then there is further scope to reduce overall costs borne by the employer. In Table 10 above, estimates are produced which assume that the costs of supervising three, five or ten apprentices are the same as for one. The numbers are somewhat arbitrary, and used to illustrate how economies of scale might further reduce the cost borne by the employer. Where three could be supervised for the price of one the cost to the employer falls to £21,000; the cost falls to £17,000 where five are supervised, and to £14,000 where ten are supervised. These amounts are hypothetical, given that it has not been possible to observe these economies of scale in practice.

Economies of scale are important, given the announcement in the 2015 Budget that an Apprenticeship levy on large employers would be introduced. The intention would appear to be to persuade large employers to over-train so that they would be able to recover the costs of paying the levy.

The results presented in Table 10 are hypothetical. Presented below are data from various other studies (a number of which were undertaken by the authors) which have addressed the productive contribution of apprentices, their wages and supervisory costs. This sheds more light on the feasibility of reducing the costs of Apprenticeship training to levels that may be akin to those found in Switzerland and Germany.

4.3.1 The productive contribution of the apprentice

Increasing the productive contribution of the apprentice would require employers to restructure their current training programmes in some way. Evidence from various studies has shown the potential for employers to offset the costs of Apprenticeship training by restructuring it through:

- shortening the duration of training (so that the apprentice becomes fully experienced / fully productive more quickly); or
- increasing the productivity of apprentices whilst training, so that their marginal productivity is closer to their wage rates over the duration of the training.

In countries such as Switzerland, where the apprentice is considered to be relatively productive over the training period – and is paid relatively low wages – this is considered to be an important reason for high levels of employer participation. Certainly compared with the German system, the costs to the employer are much lower, but even here the employer would appear to be carrying a net cost at the end of the training period.[49]

Evidence from England suggests that employers are unwilling to move away from their existing structures of training. One engineering employer commented that it was satisfied with the current structure of its engineering Apprenticeship:

49 Wolter, S. et al. (2006) *op cit*

> *"We have experimented with other forms of training but it has not given us the right sort of employee that we need. It is a big investment to have them off-site for the first year, but when they come to us in the second year they are so knowledgeable already about basic electrical skill, basic mechanical skills that they can slot right into the business straight away, and that is really, really important for us."*
> [Large advanced manufacturing employer. Source: Hogarth *et al.* 2014]

Employers had over time developed Apprenticeship training programmes that they were unwilling to move away from in order to bring down the overall costs of their training. The example of a specialist vehicle manufacturer is typical of how wedded employers providing STEM-related Apprenticeships are to their current provision of training and their reluctance to move away from it *(see panel).*

ENGINEERING CASE STUDY: SPECIALIST VEHICLE MANUFACTURER

The company produces customised refuse trucks and provides a maintenance service for their vehicles. The establishment, at which the case study was conducted, part of a larger multinational, assembles the final parts of trucks and services them as part of the after-sales service. It employs around 60 people.

When asked about meeting an increased share of the total cost of training, the respondent considered a number of options of how the employer, the apprentice, or the training provider might absorb the costs. Lowering the apprentice's wages was not considered a viable option because the company wants to attract the best students and recognises that it has to offer relatively good wages.

Changes in duration of training or type of training were not seen as an option in engineering. The existing training is required to ensure that the company has the skills it needs, especially in relation to its public liabilities. One option might be to recruit university graduates, but that also has costs attached. Similarly, there are costs attached to recruiting fully experienced workers, especially the immediate wage costs whilst they are still learning the ropes. So the company may just have to absorb the costs of training. This might be offset by apprentices working as productively as possible during their training.

In the current environment – especially in the light of recent redundancies – the company is watching costs closely, so there might be scope to negotiate costs with the training provider.

A clear decision about what the company will do would only be made at the time when any changes were introduced and after gauging how other engineering companies would react.

Source: Employer-Routed Funding Study (Hogarth et al.*, 2014)*

It is worth bearing in mind that the evidence presented above is based on employers who are willing to fund Apprenticeships at current rates.

4.3.2 Reducing apprentices' wages

As noted above, a large proportion of employers' overall costs of training an apprentice is accounted for by wages. It was shown in Table 6 that the apprentice's wages over the three and a half years of training is equal to more than 60% of the total training costs (including supervision and other costs) incurred by the employer over the same period. International comparisons reveal that apprentice wages are relatively high in England compared with countries with high levels of employer participation in Apprenticeships.[50] Table 11 provides some comparative figures. It reveals that in England, the apprentice's pay as a percentage of the fully experienced worker's wage is relatively high in each year of the Apprenticeship, compared with countries such as Germany, France, and Switzerland. Similarly, apprentice's pay expressed as a percentage of the national minimum wage is also revealed to be relatively high in England. There are a variety of complications in making international pay comparisons that result in the data being indicative. For example, it is not uncommon for apprentices to be people who were already in the employment of their employer before commencing the Apprenticeship, whereas this much less common in other countries. Consequently, such apprentices are likely to be on full adult rates at the start of their Apprenticeship training.[51] Nevertheless, there is a prima facie evidence that apprentice pay rates are relatively high in England.

Table 11: International comparisons of apprentice pay

		Apprentice pay as a percentage of the fully experienced worker's pay		
	Fully qualified workers rate (£)	Year 1 (%)	Year 2 (%)	Year 3 (%)
Germany	16.66	21	24	27
France	11.23	26	31	42
Switzerland	14.69	9	13	17
England	11.89	51	47	62
		Apprentice pay as a percentage of the national minimum wage		
	National minimum wage (£)	Year 1 (%)	Year 2 (%)	Year 3 (%)
Germany	8.85	39	45	50
France	7.52	41	49	65
Switzerland	11.62	12	16	21
England	6.19	97	90	118

Source: London Economics (2013)

50 London Economics (2013) *The impact of Further Education Learning*, BIS Research Paper No.104

51 Hogarth *et al.*, 2012

The data above relate to the average across all Apprenticeships, whereas the focus here is on STEM-related Apprenticeships. The Apprenticeship Pay Survey, periodically undertaken in England, provides an indication of the relative wage rates of apprentice training under engineering and electro-technical frameworks, respectively.[52] It shows that compared with apprentice weekly wage rates overall, apprentices under these two frameworks were relatively well paid. The data imply that, on average, those working under engineering and electro-technical frameworks are paid 6% more than the overall average weekly wage for skilled trades occupations in engineering (see Table 12).

Table 12: Apprentice wage rates under engineering and electro-technical frameworks at Levels 2 and 3

	Average hourly wage (£)	Difference from average (£)	Basic weekly pay (excluding overtime, etc.) (£)	Difference from average (£)
All frameworks	6.78		241	
Engineering	6.53	-0.25*	256	15
Electro-technical	6.94	0.16	257	16

*This may suggest that engineering apprentices work longer hours on average.
Source: Winterbotham et al. (2014)

Evidence from the Employer-Routed Funding study suggested that employers were reluctant to reduce the wages of apprentices for a variety of reasons:[53]

1. wage rates were long-established and employers were reluctant to move away from them;
2. the requirement to take on new apprentices who had a good academic record – at least five GCSEs at grades C and above, including mathematics and one science subject – required wages at their current level to be offered. This was because of competition:
    i. from schools and colleges for these students to remain in the general stream of FE;
    ii. from other employers for the same apprentice recruits.

In the Employer-Routed Funding study, there was near unanimity from employers regarding their reluctance to reduce apprentice wages to offset any additional costs they might face in delivering Apprenticeships. This was summarised by one employer as follows:

52 Winterbotham, M., Davies, B. Murphy, L., Huntley Hewitt, J. and Tweddle, M. (2014) *Apprenticeship Pay Survey 2014*. BIS Research Paper No.207

53 Hogarth et al. (2014) *op cit*

> *"The problem with apprentice salaries is that, if they are too low, we won't retain the apprentices… the issue is them taking unskilled or semi-skilled jobs at a higher salary outside our Apprenticeship scheme. If we didn't escalate the salaries fairly quickly from the starting salary, we found that we would lose them because they just couldn't afford to live, particularly those that weren't in the family home."*
>
> [Medium-sized Construction employer with a demand for various skilled trades workers. Hogarth *et al*. 2014]

The situation was similar with respect to a variety of employers that had taken on engineering apprentices. As an example, a medium-sized engineering employer (c.200 employees) that takes on one to two apprentices every year onto a four-year Apprenticeship programme, said it was not an option to reduce the wage of the apprentice:

> *"In order for us to attract the right people we have to have a certain level of salary expectation"*
>
> [Medium-sized Engineering employer that recurrently hires apprentices. Hogarth *et al.* 2014]

The company benchmarked its apprentice pay with other employers locally, and considered that it occupied a position somewhere in the middle from which it was reluctant to move.

4.3.3 Supervisory costs and economies of scale

Few employers that participated in the studies undertaken by the authors had much scope to realise economies of scale because they recruited relatively few apprentices each year.

4.3.4 Other approaches to reducing costs

The Employer-Routed Funding study which IER undertook for BIS gives an indication of the manufacturing employers' sensitivity to participating in Apprenticeships, depending upon the cost they would face in doing so. As a starting point, the study asked how employers would offset the cost, if faced with making a direct contribution of 20% and 50% respectively to training costs currently met by the State. Employers were asked to consider:

- reducing apprentices' wages;
- changing the structure of training so that the apprentice was more productive during the training period;
- shortening the duration of training;
- bringing training in-house.

As will be illustrated below, employers delivering engineering Apprenticeships saw little scope for offsetting in any of these ways, except by bringing more training in-house.

Despite a reluctance to move away from their current model of STEM Apprenticeship provision, employers were not totally impervious to cost issues. The IER Employer Routed Funding study sought to understand how employers providing engineering Apprenticeships, amongst others, might respond if they were faced with making a direct financial contribution to their training provider; in other words, meeting some of the training provider's costs currently met by the State.

A large manufacturing employer which delivered IT Apprenticeships illustrates this point (see panel).

EMPLOYER CASE STUDY: LARGE MANUFACTURING COMPANY

Asked about a possible co-investment potentially in the region of £3,000, the response was that such an increase would be too much for the company to absorb. When pushed they felt that they might possibly be able to accommodate a slightly smaller increase, but £3k was probably about the 'tipping point' where they would disengage with Apprenticeships.

Nonetheless, it was expected that the number of young people being trained would remain about the same. To accommodate the maintenance of apprentice numbers, a number of responses were thought likely:

1. all training would be brought in-house where costs could be better controlled;
2. training would become more specific to the needs of the business, and if necessary, more specialised for individuals (who might lose more general skills);
3. if (1) and (2) were incompatible with the IT Framework, then the company would continue to train young people but no longer 'badge' such training as Apprenticeship; and
4. it would consider using graduate recruitment as a substitute for the Apprenticeship programme.

Source: Hogarth et al. *(2014)*

When confronted with the potential of facing increased costs, there was a tendency for employers to say they would respond by moving training in-house. In this way they would not have to make a direct financial contribution to the training provider, or at least it would manifest itself as an internal financial transfer rather than an external payment. Whether or not employers had thought through the cost of moving more of the previously externally provided Apprenticeship training in-house is a moot point. Certainly some of the larger engineering establishments retained in-house training capabilities / centres.

Moving training in-house will only work if the cost of delivering training is no greater than using external training providers. This is then dependent, at least in part, upon being able to achieve economies of scale comparable to those that an external provider, serving several employers, is able to achieve. As the next section will demonstrate, there is evidence that some engineering employers have sought to internalise Apprenticeship training – or have always done so – and have achieved economies of scale by training the apprentices of other local companies or those in their supply-chain.

4.4 RETAINING THE APPRENTICE AND RECOUPING COSTS

If reducing the costs of the STEM Apprenticeship proves to be a major obstacle, the other side of the coin to consider is how employers can retain the apprentices they train. One of the risks employers face is that of not being able to retain the apprentice after completion of their training, and so being unable to recoup the net costs accrued over the training period. As Appendix 1 demonstrates, other things being equal in a perfectly competitive labour market, the employer will not be able to recoup the costs of their training investment, once that training has been completed.

The evidence demonstrates that employers use a number of means to ensure that they recoup their substantial investment in STEM Apprenticeships. These include:

- using the Apprenticeship training period as a way of developing a bond between employer and apprentice, such that the apprentice is not predisposed to leave the employer that trained them;
- training the apprentice in a way particular to the employer, so that they were introducing a company-specific method of undertaking certain tasks;
- putting in place a career development programme post-Apprenticeship. Employers were able to point to a range of career paths the apprentice could follow post-Apprenticeship;
- providing further training post-Apprenticeship so that former apprentices could achieve their career ambitions with the employer. This typically included training leading to completion of an HND, Foundation Degree, or first degree;
- creating a working environment more generally that was likely to increase retention rates, such as paying attention to work-life balance issues.

All of the above could be mutually reinforcing, so the employer could have a guarantee of retaining the apprentice and recouping the cost of their training investment (see panel for an example of how this worked in practice).

ENGINEERING CASE STUDY: LOCOMOTIVE RESTORATION

Ideally the establishment wants to attract an apprentice who stays with the company on completion of the training and wants to grow with the company, taking advantage of the various training opportunities the company offers. The company prides itself in 'nurturing' employees and investing in them. According to information from the training provider, progression from the National Certificate of Engineering to an engineering degree is possible when successfully completing a three-year HNC, and a one-year HND. Ideally, though, the company wants to attract someone who becomes a brilliant engineer without necessarily wanting to go on to study at university. Given that apprentices learn fairly specialised engineering skills during the training programme, the hope is that they are more likely to stay with the company after completion of their training, as there are fewer companies to choose from when changing employers.

Source: Hogarth et al. *(2012)*

In effect, the types of practice outlined above provided a lock or bond between the employer and the apprentice. Appendix 2 sets out the economics of this relationship.

Although there are practices that many employers recurrently investing in Apprenticeships had in place to ensure that they retain their apprentices, these may not be always be sufficient. For example, in cases where there is a large dominant employer, or an employer expanding rapidly with a substantial demand for skilled employees, they may be able or willing to offer terms and conditions of employment which other, smaller local employers cannot match.

It is difficult to pass more of the cost of training onto apprentices because they are usually not in a position to meet this, other than through accepting lower wages over the training period. Some of the cost could be deferred, so the apprentice meets the cost post-Apprenticeship by, for example, being expected to repay part of the cost of their Apprenticeship if they leave the employer that trained them (say over the period that constitutes the payback period for the employer). Any employer looking to recruit the former apprentice would need to pay a wage greater than that in the training company by an amount equal to the clawback amount. But this may well be more of a shackle than a lock. In practice, neither the needs of the employer nor the former apprentice are likely to be served if they are locked together in a loveless marriage. It is more credible for employers investing in Apprenticeships to have in place the practices likely to voluntarily retain their former apprentices, and the evidence suggests that many of the employers which train STEM apprentices have in place the measures to retain most, if not all, of them.

4.5 A TRAINING LEVY

Introducing a training levy is one way of increasing the overall volume of Apprenticeship training. The appropriateness of this approach is dependent upon there being some unmet demand for Apprenticeship training that a levy would address. The evidence relating to why employers do not invest in technical Apprenticeships – or do not invest more in this type of training – is limited. In most cases, it relates to a lack of demand for this form of training.[54] There are two dimensions to consider here:

1. where employers' product market strategies do not give rise to a demand for the skills that a STEM Apprenticeship will provide;
2. a failure to anticipate future skill needs that may arise from technical change, labour turnover, retirement of existing staff, and so on.

There is a considerable volume of evidence which suggests that too many employers pursue product market strategies that give rise to relatively low levels of skill demand.[55] Equally, there is evidence that employers face skill shortages that could have been offset by training more people in STEM Apprenticeships.[56] There are a number of key statistics in this regard, derived from the Employers Skills Survey 2013:

- in the manufacturing sector, employers are more likely to report vacancies, and they are more likely to respond that these are hard-to-fill (in 2013, 35% of vacancies were reported as hard-to-fill in the manufacturing sector, compared with 28% in the economy as a whole);[57]
- where hard-to-fill vacancies are in evidence in manufacturing, they are concentrated in skilled trades occupations (24% of all hard-to-fill vacancies, compared with 7% in the economy as a whole). In other words, the types of job for which Apprenticeship prepares a person to enter.

On the basis of the above, there is prima facie evidence that there is an unmet demand for skills which STEM Apprenticeships could potentially fill. Where employers could, potentially, use Apprenticeships to meet their skill demand, one of the reasons cited for not doing so is a concern that the costs of delivering the Apprenticeship are prohibitively high, and / or, they are not guaranteed of obtaining a return on the investment. The recent study of Technical Apprenticeships provided examples of this in practice, notably in relation to SMEs.[58]

54 Cambridge Policy Consultants / Mori (2008). *op cit*

55 Wilson, R. and Hogarth, T. (2003) *Tackling the Low Skills Equilibrium: A Review of Issues and Some New Evidence,* London: Department for Trade and Industry

56 Gambin L. and Hogarth T. (2015) 'Factors affecting completion of apprenticeship training in England', *Journal of Education and Work,*

57 Winterbotham, M et al. (2014). *Op cit*

58 McCaig, C. et al. (2014). *Op cit*

If a levy were introduced, as signalled in the 2015 Budget,[59] this could increase the number of Apprenticeships in large employers, but how might it affect smaller employers – i.e. those not in scope of the levy? If one assumes that the smaller employer would be expected to meet a given percentage of the overall cost of training an apprentice with the remainder being met by the State, a number of options are open to the employer not in scope of the levy:

A. stop training apprentices at all, because the levy-paying company will be able to supply them with apprentices as a free good;

B. train fewer apprentices than previously, in anticipation that larger employers over-training will not train a sufficient number of apprentices to fully meet the non-levy payer needs;

C. continue to train as previously, because they are not convinced that the larger employer will be able to produce a surfeit of the apprentices the employer requires.

Under Option A above, the risk is that the levy reduces the overall number of apprentices. Under Options B and C, there is a possibility that free-riders in the non-levy group benefit. The above might suggest that for the levy to work, it needs to be applied to all employers. This leaves aside the issue of imposing the levy on employers in sectors where there is little evidence of excess demand for the types of skill that completion of an Apprenticeship is likely to deliver.

4.6 GROUP TRAINING APPROACHES

Another means of sharing the costs of Apprenticeship training between employers, other than through a levy, is that of group training. There has been a considerable amount of research on the extent to which Group Training Associations (GTA) and Apprenticeship Training Agencies (ATA) can effectively reduce the costs of training to an employer and thereby potentially stimulate the take-up of Apprenticeship by employers.[60]

The risk faced by employers in delivering a relatively expensive STEM Apprenticeship is twofold: (a) being able to meet the training and development requirements of the Apprenticeship framework; and (b) being able to appropriate the return on the investment in the Apprenticeship. To date, there have been two principal means by which employers have been able to pool the risk attached to investing in Apprenticeships: via GTAs and via ATAs. A GTA is a training organisation that serves the training needs of subscribing companies. Apprentices can be trained using the collective resources of the subscribing companies. In this way, economies of scale can be realised. ATAs are focused on assisting mainly smaller employers who are likely to have difficulties delivering an Apprenticeship, because they face problems such as being unable to commit to a full-framework, have short-term restrictions on recruitment, or have uncertainties about the value of an Apprenticeship. The ATA is the employer of the apprentice, but is paid a fee by the company on whose behalf they are training the apprentice.

59 BIS (2015) *Apprenticeship Levy: Employer Owned Apprenticeships Training.* London: Department for Business Innovation and Skills

60 Unwin, L. (2012). *Report of the Commission of Inquiry into the Role of Group Training Associations.* London: Institute of Education / LLAKES; CFE (2013). *Apprenticeship Training Agency Model: An independent review of progress, prospects and potential.* Coventry: Learning and Skill Development Service

Elsewhere in this report, consideration has been given to how the financial risk faced by employers considering investing in a STEM Apprenticeship might be reduced. But this still leaves the risk attached to being able to manage the Apprenticeship to its conclusion; in other words, being compliant with all the obligations incumbent upon being an employer of apprentices. Case study evidence has revealed the way in which some employers, typically smaller ones or those new to Apprenticeships, rely heavily upon their training provider to help them meet all the obligations in delivering this form of training.[61] There was, in many respects, a degree of hand-holding by the training provider as they guided the employer through the Apprenticeship. It was essentially part of the tacit contract between employers and providers. The employers would take on apprentices, but the providers were there to support them through the entire process leading to the apprentices successfully completing their training. Being able to deliver this kind of support was dependent upon the providers having sufficient resources to do so.

The above evidence was drawn from employers that had made the decision to invest in Apprenticeships. In many respects the bigger question is how to put in place the support that will convince a risk-averse company to make the investment, when it is worried that it does not have sufficient knowledge or experience to fulfil its obligations to an apprentice. The ATA model potentially offers a solution here. Recent evidence shows that ATAs have allowed employers, typically smaller ones new to Apprenticeships, to host an apprentice with a view to subsequently taking the apprentice onto their books.[62] The evidence is therefore indicative of ATAs being able to increase the volume of STEM Apprenticeships. But a degree of caution is necessary. There is relatively scant evidence about the effectiveness of ATAs.[63] In particular, not much is known about deadweight: in other words, the extent to which the employer would have taken on an apprentice in any case, but decided to take the ATA approach because it conferred certain advantages (for example, it worked out as being more cost-effective). Nevertheless, there is prima facie evidence that an ATA type approach has the potential to reduce the risk faced by employers who are open to the idea of taking on an apprentice but remain undecided about doing so. By reducing that risk, the ATA model may tip them over into making the Apprenticeship investment.

Both the ATA and GTA types of approaches also have scope to increase the economies of scale, if the training provider is involved in training a relatively large number of apprentices in the same subject. As Table 10 demonstrates, this has considerable scope to reduce the overall price of the Apprenticeship to the employer, thereby reducing this risk factor.

4.7 A VARIANT ON THE GROUP TRAINING APPROACHES

Other research has demonstrated how a more organic approach to employers coalescing to deliver Apprenticeships in engineering has proved relatively successful, particularly in relation to engaging small and medium-sized enterprises (SME).[64] This has been realised through two distinct routes: 1) supply-chain relationships; and, 2) locally driven initiatives (*c.f.* local skills eco-systems).

61 Hogarth, T. et al. (2014) *Op Cit;* Hogarth et al. (2012) *Op Cit;* Gambin, L. and Hogarth, T. (2015) *Op Cit*

62 McCaig. C. et al. (2013) *Op Cit*

63 CFE (2013) *Op Cit*

64 McCaig. C. et al. (2014). *Op cit*

Considering supply-chain relationships, the following provides an example of how this has been developed (see panel).

ENGINEERING CASE STUDY: EMPLOYER-AS-PROVIDER

The focus of this case study is a global advanced manufacturing and engineering company in the civil and defence aerospace, marine and energy markets. The company has a long history of delivering Apprenticeships and trains its apprentices internally. The company also trains apprentices from the supply chain as well as apprentices from other local, large companies in the railway industry, i.e. beyond the company's own core industrial needs.

The company employ over 43,000 people globally, 22,000 in the UK and around 12,000 in the region. They currently have about 700 Apprentices, all in STEM-related subject areas; the number of apprentices has increased in recent times, but stabilised this year with an increase in Higher Apprenticeships (almost a ten-fold increase in the past three years). Despite being located in area which has traditionally been strong in the use of engineering and manufacturing Apprenticeships, the company reports shortages in the manufacturing engineering and electrical engineering areas, and has established an Early Career Programme to improve this. The programme includes Young Apprenticeships, Advanced Apprenticeships, Higher Apprenticeships, graduate programmes, and internships. At any one time, the company has around 2,000 trainees on global programmes.

The ageing workforce is a significant issue for both the main employer and their supply chain, though the main employer representative felt that the supply chain were less aware of this. 'If you look at the age profile within the sector, it's common knowledge within engineering that the average age of the workforce is near to the 50 mark'. The company are reliant on their supply chain, as 65% of their product comes through this route: '…that's why we do a huge amount of work to support them. We've actually trained apprentices for the supply chain to make sure that they've got the right skills moving forward, and they understand the challenges that they're going to face just as we do with an aging workforce on a growing order book.'

> *The reputation of the SMEs and the larger employers draws apprentices to the area. 'Apprentices move and relocate to the [region] because of the nature of the employers that they're able to work with.' The SMEs as well as the larger employers are drawing them to the area because of 'the reputation of the supply chain…[and] they're able to work in a close proximity to engineering companies that are really well-developed within the industry.'*

Another employer, at the head of the supply-chain, outlined how it insisted upon Apprenticeships being part of the contract with its suppliers:

> *"Built into the contracts we let is our principle that, for every £3m spend, they have to deliver one Apprentice, or if their workforce profile doesn't require Apprenticeships, they have to offer work placements and other types of training opportunities, workforce development, taster sessions ... So they have to put into us a plan of how they are going to deliver that."*
>
> *[Source: McCaig* at al.*, 2014]*

But the authors of the report note that this approach was rare, and that more often than not, employers at the head of the supply chain simply wanted products and services to be delivered at the cost and quality agreed, regardless of whether their supply chain recruited and trained Apprentices. There were, however, examples of larger employers making their training centres and academies available to other local employers, in an effort to cover the costs of providing these facilities. As such, there was the development of a quasi-group training association, where large employers are providing training facilities to smaller local employers. Local employers were able to make use of what often amounted to access to start-of-the-art technology and know-how. The example of a large advanced manufacturing company is instructive in this regard (see panel).

EMPLOYER CASE STUDY: LARGE ADVANCED MANUFACTURING EMPLOYER OPERATING AS A GROUP TRAINER

The company is a large advanced manufacturer which has a long history of recruiting apprentices (at Level 3) and graduates. It is highly dependent upon its supply chain to deliver the products it needs at the quality it stipulates. The importance of the supply chain and the need for quality has prompted the employer to "*train apprentices for the supply chain to make sure that they've got the right skills moving forward and they understand the challenges that they're going to face*".

As well as supporting the training of their suppliers' apprentices, the company has also become a 'community' supplier to local companies – both large and small – who send their apprentices to be trained. The training manager commented: "*There's a lot of trust between the industries…everybody looks at [the company's] flagship Apprenticeship scheme…and they want to be part of that 'if I can get my apprentice up to your standard then fantastic!' It's only going to profit the local industries and the local community*". By contributing to the pool, the employer is able to ensure that there are fewer approaches to recruit its skilled staff in an area which still has a relatively strong manufacturing base, as well as assisting with the funding of the training academy.

Source: McCaig, et al. *2014*

Another locally developed initiative sought to bring employers together to develop a training academy that trained apprentices (see panel on the next page).

A JOINT ENTERPRISE TRAINING ACADEMY

A training academy was established by several large multinational engineering / advanced manufacturing firms. It came about as a result of a historical dissatisfaction with provision on offer: "*Five years ago we as employers were so fed up with the 'state of the nation' in this region with regards to skills provision, we decided to build a consortium of employers which is actually now the LEP manufacturing forum.*" (Lead on Skills for the LEP manufacturing forum)

The general feeling across employers, providers and the Apprenticeship lead for the LEP was that Apprenticeships were at their peak in the 1980s, when the local area was particularly dependent upon the largest local employer to train apprentices for the local economy as a whole. Machine tooling skills were now in short supply, with the capacity of local employers to over-train limited.

Employers and providers are convinced the demand is there: "*We are looking at requiring around 8000 engineers in this region alone to keep up with the demand [in terms of retirement and global competitive advantage]...with the emerging technologies we have to keep on top of that...I don't think there is enough provision in this region to meet that demand.*"

The training academy founded by the large manufacturing companies has the capacity to deliver a larger number of Apprenticeships than would otherwise be the case. Apprentices work for the companies in the consortium which also includes smaller firms. Consortium employers contribute funding, master class delivery (expertise), equipment, materials and components to work on. There is also an Apprentice of the Year award.

Source: McCaig, et al. *2014*

The examples provided above indicate how, either through supply-chains or local business networks, employers can combine to engage in training, and in doing so increase the volume of Apprenticeship training undertaken.

4.8 CONCLUSION

The evidence suggests that employers who currently provide STEM Apprenticeships are unwilling to move away from their current model of delivering Apprenticeships. In general, they had little appetite for measures that might reduce the overall cost of the Apprenticeship, such as altering the structure of the Apprenticeship training they provided or reducing apprentices' wages. Whilst the existing Apprenticeship model of delivering STEM Apprenticeships works for one particular group of employers, this relatively expensive model of training delivery may serve to disincentivise other employers that could potentially benefit from training STEM apprentices. It is apparent that there may be some potential for group training approaches which can, increase the volume of Apprenticeship training via economies of scale. The approach outlined in this section tends to be based on a large employer, either at the head of the supply chain or locally dominant, which can to train apprentices on the behalf of other companies; these are notably SMEs which may have little expertise in-house to train an apprentice, and to meet the various standards laid down in the framework or Trailblazer. The examples cited are where this has taken place organically. Of course, there may need to be a catalyst such as a LEP, to bring employers together in order to meet either local or supply chain demands for the skills a STEM Apprenticeship can deliver.

Potentially the benefits are:

1. overall training costs per apprentice being reduced for the training company's apprentices, and those of the local companies (often SMEs) whose apprentices are being trained by the training employer;
2. the non-training company, and its apprentices, benefiting from having been trained under the imprimatur of the training company (which is typically a prestigious one);
3. the training facilities / expertise in the training centres of the training company being safeguarded;
4. the training costs met by the State potentially being reduced because economies of scale are generated.

There are potential risks to consider, too. Employers that subcontract their Apprenticeship training to another employer are at risk of:

1. the training company subsequently hiring their apprentices;
2. training being oriented too much towards the needs of the training company, rather than to those of the companies for which it is providing a training service;
3. the bond between the apprentice and employer in the companies that are not training their apprentices in-house being weaker than it would be otherwise.

This section started by showing that employers saw little scope for reducing the costs of the STEM Apprenticeship training (i.e. around £40,000 in engineering). But if faced with an increase in the costs of delivering an Apprenticeship, they would look to make cost savings by bringing more training in-house. This suggests that some employers would expand their existing in-house training capacity, and this could be potentially used by other employers. This then allows for a form of group training to develop along the lines outlined above.

SECTION 5 CONCLUSION: REDUCING EMPLOYER RISK ASSOCIATED WITH APPRENTICESHIP TRAINING

5.1 INTRODUCTION

The principal aim of the report is to demonstrate how demand for STEM Apprenticeships from employers might be stimulated. It has drawn on research undertaken by the authors over the past five years which has sought to understand the determinants of employers' investment decisions relating to Apprenticeships, and the factors that facilitate or inhibit employer investment in this form of training. The evidence demonstrates that there is a substantial demand for the skills that STEM Apprenticeships deliver, but that the current system may well bring about an under-supply of apprentices. This is driven in part by the costs an employer will bear in training an apprentice and concerns about being able to recoup these costs post-completion of the Apprenticeship. The research base suggests that there are several ways in which the barriers that may result in employers not making sufficient investments in Apprenticeships may be overcome. These relate to:

1. being able to reduce the net cost of the Apprenticeship to the employer;
2. developing a strong bond between employer and apprentice over the training period that increases the likelihood that the apprentice, once trained, will remain with the employer;
3. using a levy to increase the demand for training;
4. group training approaches where employers use their resources to bring about economies of scale that potentially reduce the overall cost of an Apprenticeship.

These approaches are summarised below, along with an outline of how in combination they have the capacity to increase the number of Apprenticeship starts in STEM subjects.

5.2 REDUCING THE NET COST OF TRAINING TO EMPLOYERS INVESTING IN STEM APPRENTICESHIPS

The evidence from employers which currently invest in STEM Apprenticeships indicates that they see little scope for reducing apprentices' labour costs, as they tend to set their wages at a level which will ensure that they will be able to recruit apprentices of the quality they require. Similarly, there was reluctance to move away from tried and tested structures for training apprentices so the scope for increasing the productive capacity of apprentices over their training period was limited. Nevertheless, the evidence suggests that there is wide variation in the net costs of training apprentices faced by employers, and there may be scope for ensuring that the overall net costs to the employer are reduced. Although it is difficult to make cost comparisons across countries, there is prima facie evidence that the net costs in England are higher than in Germany or Switzerland. So there may be further lessons to be learnt from these two countries in understanding how the net cost may be reduced to a level where more employers are willing to make an investment in STEM Apprenticeships.

5.3 DEVELOPING TIES BETWEEN EMPLOYER AND APPRENTICE

In general, employers that invest in Apprenticeships are willing to take the risk. The evidence is that it will take employers around three and a half years to recoup their training costs post-completion.[65] Retaining the employee for those three and a half years is achieved essentially by introducing a form of lock between the training employer and the former apprentice thus allowing the costs of training to be recouped. This was outlined in Section 4 of this report.

Lazear conceptualises the lock with respect to the specific bundles of skills that the training employer combines in delivering training akin to Apprenticeships. If regulations governing the content of Apprenticeship training are sufficiently flexible, then it should allow the employer to design an Apprenticeship programme of training that effectively increases the tie between employers and apprentices, so the latter are dissuaded from leaving the employer that trained them, and there would be a cost to any employer that sought to recruit them. The cost to the non-training employer would relate to the training they would need to deliver in order to ensure that their new recruits' skills were applicable in their workplaces.

The mix or bundle of skills is not the only feature of the bond that Apprenticeships may foster between employers and apprentices. It has been observed that Apprenticeships develop shared values between employers and apprentices. Apprentices are essentially schooled in the ways of their employer, and this further develops a tie between employer and apprentice that should allow the employer to recoup their investment in any STEM Apprenticeships they fund. Given that STEM Apprenticeships are of relatively long duration – between three and four years – there is a strong likelihood that over time a relatively strong bond will develop.

5.4 A TRAINING LEVY

The 2015 Budget announced the introduction of an Apprenticeship levy that will be applied to large companies. The extent to which a levy will be able to increase the overall volume of training is a moot point. It has been noted that there is a paucity of econometric evidence that demonstrates whether a training levy actually increases the amount of training required.[66] If the levy is applied to large companies only (however defined), then there is a need to consider how this will affect the training behaviour of smaller employers. Of interest is the extent to which those smaller employers that currently train no longer do so because it is relatively more cost-effective to rely on larger employers to over-train and then take what would be essentially a free good (i.e. a fully trained apprentice).

5.5 GROUP TRAINING APPROACHES

The tie that develops between employers and apprentices, such that the former is able to recoup the costs of training the latter, is predicated upon the employer already recognising the longer-term net benefits which accrue from Apprenticeship training. It does not necessarily address how any barriers preventing employers from delivering relatively costly STEM Apprenticeships can be lowered. This is where the group training approach – as outlined in Section 4 – has some potential. There is evidence that an ATA type approach can reduce the risks faced by employers considering, but undecided about taking on an apprentice, and

65 Gambin, L. et al., (2010) *Op Cit*

66 Gospel, H. (2012) *Understanding Training Levies*. UKCES Evidence Report 47 -

encourage them to do so. The risk is not just a financial one, as it also relates to possessing the expertise to deliver the Apprenticeship effectively.

Examples are cited in the report of the way in which employers can be brought together to deliver Apprenticeships, either through supply-chain relationships or their proximity to one another. The basic model provided is one where employers coalesce to provide a centralised training resource which multiple employers can then use. In particular it provides the potential for SMEs to engage in Apprenticeship training by being able to draw on the resources larger employers have available to them. The larger employer is provided with the economies of scale to reduce their training costs, which at the same time potentially reduces the overall cost that the smaller employer would otherwise face in delivering an Apprenticeship. Additionally, the smaller employer making use of the larger employer's training facilities can draw on the latter's expertise and experience of delivering Apprenticeships.

5.6 IMPLICATIONS OF THE FINDINGS

The current model of delivering STEM Apprenticeships is a relatively expensive one. Those employers that recurrently invest in STEM Apprenticeships clearly find this investment worthwhile, otherwise they would not continue to do so. But if the aim is to increase the number of employers and individuals engaging in Apprenticeships, then it is unlikely that the current system or model of delivering STEM Apprenticeships will be able to deliver that goal. There are two principal issues that need to be addressed in considering how more employers with a demand for STEM skills may be persuaded to invest in STEM Apprenticeships. These are:

1. reducing the net cost of Apprenticeship training to the employer; and
2. ensuring that the employer is able to retain the apprentice once trained, so the employer is able to recoup its investment in Apprenticeships.

These are not mutually exclusive. The starting point is that STEM Apprenticeships represent a substantial investment by employers. Employers may not be willing to make the level of investment required because of concerns about both being able to afford the level of investment required and to appropriate the returns on that investment (because other companies may recruit their former apprentices).

The evidence presented here is that employers see little scope to reduce the overall costs of delivering STEM Apprenticeships: apprentices' wages are set a rate that will ensure that the employer can recruit apprentices of the quality it requires; and training is structured in a way that efficiently delivers the skills the employer requires. But the evidence from Germany and Switzerland suggests that their Apprenticeship systems are able to deliver high quality training at lower net cost to the employer than in England. Clearly, a high degree of caution is required in making comparisons between countries, especially when the methods used to determine the net costs to the employer vary so much. But there has to be merit in looking more closely at how these countries structure and finance their training.

The other side of the coin relates to how employers are able to retain their apprentices once trained and thereby recoup the overall cost of their investment in Apprenticeships. Artificial means of ensuring the apprentice remains with the employer that trained them for a given period, such as introducing clawback clauses in the Apprenticeship contract, are unlikely to prove effective. They may dissuade would-be apprentices from undertaking an Apprenticeship in the first instance, and they are likely to prove difficult to implement in practice. Rather, the focus has to be on more voluntary means. Within this, however, there has to be some means of allowing the employer to tailor Apprenticeships to their particular needs, such that there is a potential cost to any other employer looking to recruit the training employer's apprentices. This may limit the mobility of apprentices over the very earliest stages of their career, insofar as it imposes a cost on the recruiting employer.

The report has provided hypothetical examples of the ways in which the overall net costs to the employer may be reduced. Whether or not these types of change are feasible is a moot point. It is important to bear in mind that it is not all about reducing cost; it is also important to consider how the employer is able to retain and recover the costs of their training investments. Clearly, a lower cost means that there is less of a cost to recover, which may make employers less concerned about the risk attached to recovering the investment. If Apprenticeships are to be a human capital investment for the employer that is designed to meet the medium to long-term goals of the employer, and in aggregate the State, then it is likely that the employer will be carrying a net cost at the end of the training period. Hence the importance of placing a degree of emphasis on the employer having in place those policies and practices that will retain the former apprentice.

A training levy and group training approaches may be mechanisms for engaging employers in Apprenticeships. Though the extent to which a levy can increase Apprenticeship starts in STEM remains to be seen, unless the underlying economics of training are right, employers will remain unwilling to make the required investments. Moreover countries that are able to more persuade employers to train apprentices may be gaining a competitive advantage.

APPENDIX 1 THE HUMAN CAPITAL MODEL AND RECOUPING EMPLOYERS' COSTS OF TRAINING

The human capital model of employer training investments can be formally expressed as follows.[67] Assuming that companies are profit maximising, their total labour costs (*TLC*) will be equal to the marginal product of labour (*MP*), suitably discounted over time at a certain discount rate (*r*). Over two periods (1 and 2), the relationship between *MP* and *TLC* can be denoted as:

$$TLC_1 + \left(\frac{TLC_2}{1+r}\right) = MP_1 + \left(\frac{MP_2}{1+r}\right) \qquad (1)$$

Where employers provide training to employees in the first period, employment costs over the two periods will be equal to the wage of the employee (W_1 in the first period and W_2 in the second period) plus training costs (S_1, incurred in the first period) so that the costs of employment will be:

$$W_1 + S_1 + \frac{W_2}{1+r} = MP_1 + \left(\frac{MP_2}{1+r}\right) \qquad (2)$$

In the second period, the training employer cannot avoid paying a wage which is equal to the marginal product of the employee, because all employers, irrespective of whether or not they provide training themselves, will be willing to pay wages, W_2 , at such a level (where training is general or transferable to be of benefit in other workplaces). Therefore the employer which provides general training needs to recoup the costs of the training it provides over the training period, rather than relying on doing so in the post-training period. The wage paid in the first period (the training period) must be equal to the marginal product of the employee minus the costs of training:

$$W_1 = MP_1 - S_1 \qquad (3)$$

If the employer attempts to recoup the costs of training in the latter period, it could only do so by paying a wage lower than the employee's marginal productivity in that period. But, other things being equal, the employee would be expected to move to another employer which pays wages equal to MP_2 rather than staying with the training employer paying a lower wage.

67 Hogarth and Gambin (2015): 'Factors affecting completion of apprenticeship training in England', Journal of Education and Work,

APPENDIX 2 THE ECONOMICS OF ESTABLISHING A BOND OR LOCK BETWEEN EMPLOYER AND APPRENTICE

This section sets out the formal relationships between the value of the bond between employers and apprentices, and the potential for economies of scale to increase the volume of training undertaken. It picks up from the standard human capital model outlined in Section 3. For the reader more interested in the implications of the findings presented above, this appendix can be skipped.

The value of the lock or bond between employer and apprentice is denoted by B. Assuming that the training employer has not been able to pay a wage in period 1 which completely offsets the training costs incurred in that period (i.e. $W_1 > MP_1 - S_1$), the net costs of training will be carried forward into period 2 – this is denoted as TC_2. The employer would then be looking to pay a wage lower than the marginal productivity of the trained worker, in order to recoup this cost. In period 2 the employer would seek to pay a wage to the trained employee such that:

$$TLC_2 + W_2 + TC_1 + B_2 = MP_2$$

$$W_2 = MP_2 - TC_1 - B_2$$

Implying that $W_2 < MP_2$ where $TC_2 > 0$ and/or $B_2 > 0$.

The 'lock' between the training employer and the newly trained apprentice can be viewed as a benefit to the employee, too, such that they would only be inclined to leave their training employer if the wage on offer from another employer exceeded the wage they receive from their training employer and the value of the lock, B. One can think of the lock as in effect raising the reservation wage of the employee so that they would require a higher wage with an external employer than with their training employer. If the non-training employer wants to hire the apprentice, then it will need to pay a wage that is sufficiently large to compensate the ex-apprentice for the value of B:

$$W_{2,external} \geq W_2 + B$$

One way of increasing the incidence of Apprenticeship training is finding a means of ensuring that B is sufficiently large to avoid apprentices post-completion being poached by non-training employers, but not to the level that the costs are so disproportionately large that labour mobility is substantially compromised.

The above may be sufficient to explain the current incidence of training, but not necessarily an incentive to increase the number of Apprenticeship starts in STEM subjects. One way of further reducing the risk faced by employers in training apprentices is with respect to the overall cost of training apprentices. One way of achieving this goal is to capture economies of scale in some way, such that the overall cost is reduced by a given factor. The importance of this needs to be seen with respect to those employers, especially SMEs, which may have an intermittent demand for apprentices, and when they do it results in just one apprentice being recruited. There are relatively high costs to the employer in this situation, not least where they are not experienced in taking the apprentice through this form of training. Approaches such as Group Training Associations (GTA) – that potentially allow for economies of scale to be realised – have, in practice, struggled to expand the number of employers they engage. An alternative approach is that of using existing employers, with a substantial training capacity, to over-train by taking on apprentices which are employees of other companies. This potentially reduces the overall training costs (*TC*) but may reduce the strength of the lock or bond between employer and apprentice (*B*). In cases where an external employer pays the wages and at least some of the training costs to have an apprentice trained by an over-training firm, the value of the lock between the 'home' employer and their apprentice is essential in ensuring that the employer is able to recoup the costs they have incurred in getting their apprentice trained.

Where the increased numbers of apprentices being trained by an over-training firm (say firm *OT*) results in economies of scale such that the per apprentice training costs are reduced (i.e. $S_{1,OT} < S_1$). The bond between the over-training employer and their own apprentices would be unaffected by the fact that the company would be training additional apprentices. At the same time, the non-training 'home' firm of these additional apprentices would incur some training costs (with $S_{1,OT}$ being the maximum they would pay to the over-training firm), as well as the wage costs for their apprentices ($W_{1,home}$). For the non-training home firm, the total cost of training (net cost) carried forward at the end of the first period would be:

$$TC_{1,\,home} = W_1 + S_{1,\,OT} - MP_{2,\,home}$$

And, as $S_{I,OT} < S_I$ (due to economies of scale), then $TC_{1,home} < TC_1$, all else held the same, where TC_I would be the net total cost of training without economies of scale. After completion of the apprenticeship (period 2), the home employer would seek to pay below their ex-apprentice's marginal product (as seen above), such that:

$$W_{2,\,home} = MP_{2,\,home} - TC_{1,\,home} - B_{2,\,home}$$

For the home firm, there still may be a bond, $B_{2,home}$, developed between them and their apprentices (being trained on another employer's premises), but this is likely to be weaker than the lock that would be in place if the apprentice was trained directly by the home employer (i.e. $B_{home,2} < B_2$). This would be expected to result in the home employer having to pay closer to the ex-apprentice's marginal productivity (which would result in an increased payback period, thus requiring the employer to retain the ex-apprentice for longer), though this will also depend on the net total training costs remaining at the end of the training period. It would, of course, be possible for the home employer to strengthen the lock between them and the apprentice further in the post-training period, as the apprentice will then be with the home employer at all times. This lock may be in the form of the specific combination of skills and attitudes apprenticeships deliver (which may be further tailored to the home employer when the apprentice is in their workplace) as well as the instilling of company values and culture in the apprentice.

One possible drawback, however, of home employers having their apprentices trained by typically larger over-training firms is that this may provide apprentices with greater knowledge of the alternative employment opportunities open to them after completion of their training. This further illustrates the need for the home employer to ensure they develop a way of 'locking' apprentices into their organisation, at least for some period after completion.

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