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SKILLS AND TRAINING FOR A MORE INNOVATION- INTENSIVE ECONOMY

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Skills and training for a more innovation-intensive economy

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Abstract

There is now intense interest in developing a new industrial policy for the UK which, among other aims, will encourage more UK-based firms to shift towards higher value added activities in a range of industries. In this paper we argue that, if any such industrial policy is to be effective in improving UK economic performance, it needs to stimulate higher levels of innovation by firms. In particular, the policy must encourage a sizeable number of firms who do not currently engage in innovation to start doing so. This in turn implies an increased demand for innovation-related skills and knowledge by UK firms that is unlikely to be met by an industrial training system which is beset by historical weaknesses. Thus the emergence of new industrial policy needs to be complemented by new training policies designed to make skills development and utilisation more cost-effective and to stimulate higher levels of employer demand for innovation-related skills and training. These new policies will need to be balanced in three dimensions: between technical and generic skills, between higher and intermediate skills, and between initial and continuing education and training.

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1. Introduction: the need for a skills strategy

A successful system for skills development and utilisation is a basic ingredient for economies and nations to grow and maintain the competitiveness of their workplaces. It is also crucial for the cohesion of societies, including the limitation of income inequalities and social exclusion. The need for skills strategies arises because the skill needs of modern societies are changing and education systems are expanding. The pace of these changes implies that piecemeal, ad hoc, adjustments to vocational education and training systems, and normal business evolutions, risk the creation of skills mismatches and inefficiencies in the system that can be greatly detrimental to economic and social well-being. When introducing a progressive industrial strategy, the need for an effective skills strategy is even more pressing.

Among the principal aims of a new industrial policy for the UK will be to achieve a rebalancing between manufacturing and service sectors and a shift towards higher value added activities in both old and new industries. New product and process innovations will be central to any such shifts in production structure and much attention is paid to the need for the UK to learn from other countries which have proved in recent decades to be more successful with innovation and with the commercialisation of the results of research and innovation. Yet there are no guarantees that particular industrial policies that have worked well in different times and countries will enjoy similar success in the future, even in those same countries, let alone in other places. Furthermore, in the UK as in other countries, product and labour markets and socioeconomic institutions have their own deeply rooted characteristics that need to be taken into consideration in the design and development of industrial and skills policies. In particular, industrial policy design in the UK needs to confront a level of research and innovation activity which appears to be markedly lower than in many other countries which the UK is urged to emulate (Hughes and Mina, 2012).

Mason and Nathan (2014) review policies and programmes that have sought to improve UK innovation performance by fostering knowledge transfer flows and research collaboration between firms in particular sectors and between firms and universities. They find that the relatively low proportion of innovative firms in the UK has hampered efforts to emulate successful foreign programmes such as the Small Business Innovation Research (SBIR)

programme in the US. In addition, the limited number of UK firms with innovative capacity restricts the potential to operate successful home-grown programmes such as SMART (formerly Grants for Research and Development) and Knowledge Transfer Partnerships (KTPs) on a larger scale than has been achieved so far.

The premise of this paper is that a new industrial policy, if it is to be effective in improving UK economic performance, needs to encourage higher levels of innovation by firms. In particular, the policy must encourage a sizeable number of firms who do not currently engage in innovation to start doing so. In this paper we focus in particular on what types of skill and knowledge such firms need if they are to become more innovative – and then what changes in training policy and institutions might help develop those skills and knowledge.¹

The paper proceeds as follows. In section 2 we identify in general terms the skills needed to improve innovative performance. We then outline in section 3 a picture of skills and training trends in Britain, in which we identify the core of the problem facing British workplaces to be a "skills deficit" -- a relatively low level of employer demand for skills as well as relatively low levels of skills supply -- appropriate for an economy with low levels of innovation and investment but not for an economy seeking to introduce a progressive industrial strategy. Sections 4 and 5 outline current training policy and the principles we believe should underpin an improved policy framework. Then, the final substantive section looks at the issues of quality and balance in skills development.

¹ We use ‘skills’ in a broad sense, covering all levels and types (including knowledge), defined as personal characteristics that add value and can themselves be invested in (Green, 2013: Chapter 2).

2. The skills needed for improved innovation performance

The term ‘innovation’ is now widely agreed to range beyond research and development (R&D) activities and outputs and indeed to extend beyond the introduction of new products and processes. In the *Oslo Manual* guidelines published by the OECD and Eurostat in 2005, innovation is defined as:

‘the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations..... The minimum requirement for an innovation is that the product, process, marketing method or organisational method must be new (or significantly improved) to the firm. This includes products, processes and methods that firms are the first to develop and those that have been adopted from other firms or organisations’ (OECD/Eurostat, 2005: 46)

Estimates derived from the UK Innovation Survey 2011 suggest that, between 2008-10, approximately 39% of UK firms were engaged in innovative activity of some kind (BIS, 2013a). This definition of ‘innovative firms’ includes firms which had introduced products or processes that were new to themselves but not to other firms in their industries. In total, just under one in five firms had introduced new products, and of these some 46% reported that the products were new to their markets (that is, introduced before their competitors). About one in ten firms had implemented new or significantly improved processes for producing or supplying goods or services, of which about a quarter (26%) reported the process innovations as new to their industries (ibid).²

What influence do skills have on innovative performance? In recent reviews of the literature on how innovation is affected by skills and training at firm level, OECD (2011a) find evidence of positive associations between firms’ involvement in innovation and proxy measures of skill such as workforce qualifications while Jones and Grimshaw (2012) find similar positive links between innovative performance and expenditures on training. Skilled people are likely to be well-placed to generate new ideas and knowledge relevant to

² Estimates from the last UK Innovation Survey (UKIS) carried out before the 2008-09 recession show a much higher level of firm engagement in innovative activity (61%) during the 2006-08 period than was later found for 2008-10. The estimates of product innovators (24%) and process innovators (13%) were also higher for 2006-08 than for 2008-10 but the ratios of new-to-firm and new-to-market/industry innovations were much the same in both time periods. BIS (2013a) points out that UKIS results for 2006-08 are not directly comparable with those for 2008-10 due to changes in sampling procedures and survey design; however, they conclude that ‘it seems safe to say that there was a fall of several percentage points in the [proportion] of innovation active firms over the period’ (BIS: 2013a: 7)

innovation, make improvements to existing products and processes and adapt to changing circumstances. However, skills and training are not sufficient in themselves to enhance innovative performance. Rather, they may contribute positively to innovation when they are combined with other important production inputs such as investments in physical capital (e.g., machinery and equipment), in capacity for research, design and development and in organisational capital (e.g., improvements in work organisation and other business practices and processes).

Many of the key mechanisms by which skills influence innovative performance are connected with new technologies. For example, US evidence suggests that skills play a key role in facilitating the effective utilisation of Information and Communication Technologies (ICTs) and that there has been a complementarity over several decades between ICTs and the educated labour required to perform non-routine tasks (Bresnahan, Brynjolfsson and Hitt, 2002; Autor, Levy and Murnane, 2003). A number of studies in European countries have also found evidence of a positive relationship between workforce skills and the adoption of ICTs (for example, Hollenstein, 2004 and Bayo-Moriones and Lera-López, 2007). The principal mechanisms involved are that high skilled workers can contribute more than low skilled workers to the selection, installation, operation and maintenance of ICTs and also to the adaptation of ICTs to firm-specific requirements.

Other important mechanisms by which skills may affect innovative performance include knowledge transfer processes, for example, the transfer of knowledge between firms, sectors and countries through collaboration on R&D and technical problem-solving among skilled workers involved in supply-chains (Lundvall, 1992), the mobility of highly-qualified engineers and scientists between firms (Saxenian, 1994; Mason, Beltramo and Paul, 2004) and the impact of foreign direct investment (FDI) which research evidence suggests is attracted to economies with a high skills base while simultaneously bringing with it new technologies and knowledge which augment the skills base of host countries (Barrell and Pain, 1997; Blomstrom and Kokko, 2003). However, the impact of multinational enterprises on host-country innovation may be reduced if host-country firms lack the 'absorptive capacity' to take full advantage of new knowledge and technologies or are unable to withstand the increase in competition.

‘Absorptive capacity’ here refers to the ability to identify and make effective use of knowledge, ideas and technologies that are generated outside each firm (Cohen and Levinthal, 1989). As suggested by Zahra and George (2002), it is useful to distinguish between potential absorptive capacity (the ability to acquire and assimilate external knowledge) and realised absorptive capacity (the ability to transform and apply acquired knowledge within organisations). At each stage of this process – recognising useful external knowledge, seeing how it might be applied and then successfully making use of it within firms – workforce skills have a key role to play. Furthermore, supply-chains involving foreign investors have greater prospects of becoming ‘developmental’ in nature (with close collaborative relationships between supply-chain partners) rather than ‘dependent’ (with suppliers being used primarily to cut costs) if prospective host-country suppliers are well endowed with skills.³

In some industries such as auto and aerospace manufacturing, the lead customers in supply-chains now seek to speed up new product development times and reduce costs by requiring first-tier and second-tier suppliers to produce goods to meet performance specifications rather than to conform with blueprints (Brown, 1998; Petersen, Handfield and Ragatz, 2003). This obliges suppliers to develop their own design capabilities and, for those firms with the skills base to succeed in doing so, future growth prospects may be enhanced by increased knowledge spillovers within those supply-chains. Brown (2000) shows how supplier linkages of this kind contributed to rapid employment growth in high-tech firms supplying specialised services to aerospace customers in West Sweden.

Much of this evidence on the positive relationship between skills and innovation emphasises the role of high-level skills (e.g., university graduates) rather than intermediate-level skills (e.g., technicians, craft workers and other employees with qualifications below university graduate level). However, there are a number of ways in which the skills of non-graduate workers can also contribute to innovation. For example, Toner (2010) notes that incremental innovations in products, services, processes and modes of work organisation rely heavily on workers in direct production, marketing, finance and human resources departments who have developed new ideas through learning-by-doing in the course of their work. In countries like Germany with well-established apprenticeship training systems, intermediate-skilled workers

³ For more discussion of this distinction between developmental and dependent supply-chains, see Turok (1993) and Brown (2000).

are particularly well equipped to make modifications and improvements to production processes and assist with bringing complex new products into commercial-scale production (Prais, 1995; Mason and Wagner, 2005).

Intermediate-level skills also make key contributions to absorptive capacity at firm level. Using the distinction suggested by Zahra and George (2002), highly skilled employees such as professional engineers and scientists may well contribute disproportionately to potential absorptive capacity (the identification and acquisition of useful external knowledge) but firms' ability to apply this knowledge (i.e., realise their absorptive capacity) will depend in many ways on intermediate-skilled employees as well as on high-skilled employees. For example, there are many key support roles for technicians in product design and development areas and for craft-skilled workers in improving production processes.

In addition to assessing the mix of skill *levels* required for successful innovation, we also need to consider available evidence on the different *types* of skill which are most relevant to innovation. In general, this evidence points to a wide diversity in skill needs, reflecting the several different types of innovation which are relevant to economic performance (including, as noted above, marketing and organisational innovations as well as product and process innovations). A recent OECD review of skill requirements for innovation cites a wide range of technical and practical skills, generic skills (such as communication and problem-solving skills) and managerial and entrepreneurial skills which have been found to support innovation in different workplaces, industries and countries (OECD, 2011a).

In order to shed more light on the different types of skill that are most likely to be in demand by firms engaging in innovation, it is worth reviewing research evidence on labour market returns to different types of skill. In some European countries employer surveys and analyses of pay data suggest that employers place a high value on practical skills and experience which are best acquired through employment-based training such as apprenticeships (Winkelmann, 1996; Gangl, 2000; Mason, 2001; Fersterer and Winter-Ebmer, 2003). However, other researchers suggest that the innovation and performance benefits of vocational education and training (VET) may be less than those deriving from general education. For example, Krueger and Kumar (2004) develop a model of technology adoption and economic growth which suggests that specialised vocational education in some Continental European countries may be less well suited to developing the skills needed to

adapt to fast-changing technologies than general or academic education which is more common in the US. In the UK this assessment is supported by evidence of a large positive wage premium attached to having studied mathematics during post-compulsory secondary education. Dolton and Vignoles (2002) argue that mathematics study at this intermediate level of education helps to develop generic skills such as logical thinking and problem-solving which are closely matched to many employers' skill requirements.

In common with the US, the use of high-level skills in the UK has been reinforced by the growth of mass higher education since the late 1980s. As shown in Table 2.1, the graduate share of UK persons in employment rose steadily from 14 percent in 1993 to 31 percent in 2013 while the shares of intermediate-level qualifications (both vocational and general in nature) remained fairly steady over this period as the proportion of the workforce with low or no formal qualifications declined sharply. In general, the fact that average returns to graduate education have held up fairly well since the early 1990s suggests that demand for graduate-level skills has largely matched the growth in graduate supply (Machin, 2003; Walker and Zhu, 2008), even though there has been some widening in the dispersion of returns to university education and there are concerns about under-utilisation of some graduates' skills (Green and Zhu, 2010).

Overall, the highest salary returns to educational qualifications are still found to derive from a 'standard academic route' through GCSEs and A levels (or their equivalents in Scotland) to Bachelor and higher degrees (McIntosh, 2006; Powdthavee and Vignoles, 2006). In the case of intermediate vocational qualifications, average returns are positive at NVQ Levels 3 and 4 even though they are not as high as returns to academic or general qualifications at the same levels. At Level 3 and above, intermediate vocational qualifications are most rewarding to people who left school without any qualifications at all. But at Level 2 returns to vocational qualifications are often very low or even zero (ibid).

However, qualifications are imperfect measures of skill. When we look at other indicators of skills demand within firms apart from returns to different levels of qualification, it becomes clear that a more innovation-intensive economy is likely to need a wide range of types and levels of skill. In the 2013 UK Commission's Employer Skills Survey (UKCESS), as many as 71 percent of UK establishments reported that some of their employees needed to acquire new skills or knowledge, with many of these new skill requirements deriving from innovation-related factors such as the introduction of new goods or services and new work

practices and new technologies (Winterbotham et al, 2014). These skill updating needs, which were also evident for employees deemed competent to perform current tasks (i.e. most employees), were reported across a wide range of occupations but applied particularly to professionals, personal service workers, managers and skilled trades workers (Table 2.2). Across all occupations the main types of skill in need of improvement included technical and practical skills, planning and organising skills and problem-solving skills. Other priority skill updating needs included advanced IT/software skills for managers, professionals, associate professionals and administrative and clerical workers and customer handling skills for workers in sales and elementary occupations (Winterbotham et al, 2014, Table A.3.8).

In analysis of similar survey findings for 2009, the highest levels of employer demand for skills improvement and updating among existing staff were found in firms which were seeking to implement high value added product strategies (Mason, 2011).⁴ The term ‘product strategy’ here refers to the choices made by firms about product or service differentiation within particular markets. High value added product strategies are more likely to be based on new product development and other forms of innovation rather than reliance on existing products or services of long standing. High value added firms are also more likely to seek to compete on high-specification products at premium prices in certain markets while less innovative or non-innovative firms target the lower-priced end of those markets or opt for a medium-price strategy.

In this section we have argued that an industrial strategy that promotes innovation in previously non-innovative firms will entail an increased demand for skills of several types and at both intermediate and upper levels. The supply of skills will therefore need to be enhanced. In the next section, we consider to what extent the current skills system in Britain is already set on an expansionary path.

⁴ In multivariate analysis of NESS data, the probability of firms reporting skill improvement and updating needs was found to be significantly positively related to a summary measure of product strategy based on indicators of innovation leadership, product quality and the extent to which firms depended on low prices in order to compete successfully. The skill updating needs which were identified were also positively linked to business strategies involving the targeting of national and international product markets rather than local or regional markets (Mason, 2011).

Table 2.1: Highest qualifications held by persons in employment aged 16-64, UK, 1993-2013

	Graduates	Upper intermediate: above NVQ3, below Bachelor degree level	NVQ3-Vocational	NVQ3-General	NVQ2-Vocational	NVQ2-General	Low or no qualifications	Other qualifications	Total
<i>Percent of total persons in employment aged 16-64</i>									
1993	14	9	16	7	3	17	28	6	100
1994	13	10	16	7	3	18	24	8	100
1995	14	10	16	7	2	19	23	8	100
1996	15	10	16	8	3	19	22	8	100
1997	15	10	16	8	4	19	20	8	100
1998	15	10	16	8	4	20	19	8	100
1999	17	10	16	8	4	19	18	8	100
2000	17	10	16	8	4	19	18	8	100
2001	18	10	16	8	4	19	17	8	100
2002	19	10	16	9	5	19	16	8	100
2003	19	10	15	9	5	18	16	8	100
2004	20	10	15	9	5	18	16	7	100
2005	21	10	14	9	5	19	14	7	100
2006	22	10	15	9	6	18	13	7	100
2007	23	11	14	9	6	17	13	8	100
2008	24	10	14	10	6	17	12	8	100
2009	25	11	14	9	6	17	11	7	100
2010	27	11	14	9	6	15	10	7	100
2011	28	11	14	9	7	16	10	5	100
2012	30	11	14	10	7	15	9	5	100
2013	31	11	14	9	6	15	8	5	100

Source: Labour Force Survey (Spring quarters)

Note: Population-weighted estimates. Qualifications are classified as follows:

Graduates: Bachelor degrees or above.

Higher education above National Vocational Qualifications (NVQ) Level 3, below Bachelor degree level: e.g., Foundation degrees, Higher National awards, sub-degree qualifications in teaching and nursing and equivalent awards; Diplomas in Higher Education and other higher education qualifications below Bachelor degree level.

NVQ Level 3 – Vocational: e.g., BTEC National awards, City & Guilds advanced craft and craft awards, completed trade apprenticeships and equivalent awards

NVQ Level 3 – General: e.g., A level, A-S level, Scottish CSYS, Scottish Higher and equivalent awards; GNVQ Advanced awards

NVQ Level 2 – Vocational: e.g., BTEC General and First awards; City & Guilds awards below craft level; SCOTVEC National Certificate modules; YT, YTP certificates and equivalent awards.

NVQ Level 2 – General: e.g., GCSE grade A-C, O level, CSE grade one and equivalent Scottish awards; GNVQ Intermediate and Foundation awards

Table 2.2: Single occupation most affected by skill updating needs, UK Commission's Employers Skills Survey, 2013

	Percent of establishments which employ staff in each occupation	<i>n</i> =
Managers	32	44018
Professional occupations	40	8739
Associate professional and technical occupations	29	6268
Administrative and clerical occupations	12	26945
Skilled trades occupations	31	11811
Personal service occupations	37	6973
Sales and customer service occupations	29	13690
Process, plant and machine operatives	21	7002
Elementary occupations	14	16100

Source: Derived from Winterbotham et al, 2014, Figure 3.3.
 Base: All establishments which employ staff in each occupation

3. Existing skills and training in the uk: outcomes and problems

A traditional response to the long-standing productivity problems of the British economy has been to attribute the problems to skill shortages and to an education system said to prepare students poorly for the world of work. Despite much evidence to the contrary, this misleading diagnosis recurs in modern discourse, not least because it deflects from the need to address with employers the problem of skill development at work. In reality, the issue for policy-makers is Britain's 'skills deficit', the relatively low level (by international standards) of *both* supply and demand for skills in many parts of the British economy. Correspondingly, there is also a 'training deficit', that is, a relatively low level of training supply and demand.

Conceptual clarity is important at this point. A 'skills deficit' describes where the skills being used are below a widely-recognised optimum. The latter is conceived as the level of skill consistent with a growing, sustainable economy at the technological frontier. A skills deficit can best be indicated by comparison with good practice and outcomes observed in other economies, though international comparisons must be interpreted with care. A 'training deficit' is where the level and quality of training are sub-optimal, defined and indicated similarly. 'Skills shortage', by contrast, is a disequilibrium concept, capturing the difference between market demand and supply. It is indicated by evidence of recruitment difficulty, where the reason for the difficulty is insufficient job applicants with the required skills. A parallel disequilibrium concept for the internal labour market (i.e. firms' existing workforces) is 'skills gap', where incumbent workers lack adequate skills to perform their jobs competently. It is typically indicated by managers' evaluations. The opposite of skills shortage is skilled worker unemployment, while the opposite of skills gap is employees' perceptions of skills underutilisation. Finally, there can also be a mismatch or disequilibrium in the training market, of which the most likely is a 'training barrier', whereby workers (or employers) have an unmet demand for training.⁵

The conclusion that Britain has a skills deficit relative to other industrial nations -- and a corresponding training deficit -- derives, not from any single decisive observation, but from a patchwork of evidence drawn from a variety of sources. One source is cross-country comparisons of Human Resources in Science and Technology (HRST) which are defined as 'persons having graduated at the tertiary level of education or employed in a science and technology occupation for which a high qualification is normally required and the innovation

⁵ For further elucidation of these and other concepts and indicators, see Green (2013: Chs 2-4).

potential is high' (OECD, 2013a: 92). 'Science and technology' is here broadly defined to include social sciences and humanities as well as the physical sciences, engineering and technology (OECD, 2011a: 23) Table 3.1 focuses on professional and technician-level (associate professional) occupations and shows that HRST accounted for 37% of total UK employment in 2012, below several high-innovation countries such as the US, Denmark, Sweden, Switzerland, the Netherlands and Germany.⁶ Countries below the UK on this measure included several low-innovation Southern European nations.

Table 3.1: Human Resources in Science and Technology (HRST) as a percentage of total employment, 2012

	Professionals (ISCO 2)	Technicians and associate professionals (ISCO 3)	Total
Denmark	26	17	43
Sweden	25	17	42
Switzerland	24	18	42
United States	23	18	41
Norway	24	17	41
Finland	23	18	40
Netherlands	23	16	40
Germany	18	21	39
France	17	20	37
United Kingdom	24	13	37
Belgium	22	15	37
Austria	15	19	34
Ireland	22	11	34
Italy	14	17	31
Spain	17	11	28
Greece	19	8	27
Portugal	15	10	25

Source: OECD, Science, Technology and Industry Scoreboard 2013

Note: ISCO = International Standard Classification of Occupations, 2008

One distinctive feature of HRST stocks in the UK by this measure is the relatively low share of intermediate-skilled technicians compared to that of professionals (typically university graduates). The sharp rise in the graduate share of the British population and workforce since

⁶ For comparisons of innovation-intensity in the UK and other countries (measured as business spending on R&D and other forms of innovation as a proportion of industrial value added), see Hughes and Mina (2012).

the early 1990s (described in Section 2 above) signals a lasting social change whose wider significance remains to be fully assessed. But although the speed of this change might seem rapid in historical context, education levels are rising even faster in many comparator economies. Moreover, forecasts of future education levels – typically based on comparisons between the education levels of younger and older cohorts – suggest that the average educational level continues to grow less rapidly than in the majority of other countries. In 2009 some 82% of those aged 25-34 had attained at least upper secondary education levels, but this proportion was exceeded by 25 other countries (OECD, 2011b).

At the same time, there is evidence from the OECD's Survey of Adult Skills (SAS) in 2012 of a relatively low demand by UK employers for their employees to have educational qualifications: according to SAS, the proportion of jobs in England and Northern Ireland where tertiary qualifications are required for entry is among the lowest in the OECD. The proportion of over-qualified workers – those whose qualification level exceeds the level required for someone to be recruited to their job – is the second highest in the OECD (OECD, 2013b: 168-171). This comparative finding reflects the trend towards increasing overqualification in Britain as a whole between 1986 and 2006, and which was only reversed slightly between 2006 and 2012 (Felstead et al., 2013).

This macro-level evidence using education as a proxy for skill is complemented by detailed sectoral studies that typically indicate relatively low level of skills use in British industry. In this vein, a particularly influential genre was the matched-plant study: using the methodology of qualitative comparison in matched plants in comparator countries, several studies found evidence of low use and low stocks of intermediate skills in British plants (Prais, 1995). Typically these studies also found a link between skills and productivity differences.

SAS also provides some direct evidence of relatively low skills supply which complement comparisons based solely on formal qualifications. In England and Northern Ireland numeracy proficiency is significantly below the OECD average, while literacy proficiency is close to the average. However, for both literacy and numeracy the proficiency of the older population is relatively high compared to many other countries, while that of the population aged 16-24 is among the lowest of all countries. High levels of inequality characterise the skills of the younger population in England and Northern Ireland, as well as relatively high “social gradients” (the link between skill and parental background – an inverse indicator of social mobility) (OECD, 2013b; BIS, 2013b; Green, A. et al, 2014).

As well as an overall skill deficit, a common specific diagnosis is that there is a deficit of management skills in Britain. Recent survey evidence has shown that on average British managers lag behind many foreign counterparts in implementation of practices known to enhance productivity (covering four domains: operations management, performance monitoring, target setting and talent management). The UK average management score for use of 18 management practices lags behind the North American and most Northern European countries, while exceeding those in southern European countries and a number of developing countries. Moreover, practices were found to vary substantially within the same industry and country, and there is a relatively long tail of poorly managed firms in Britain. The achieved education level of managers, in particular, was found to be a significant determinant of whether managers adopted effective practices. As shown in Table 2.2 above, some 32% of UK firms in 2013 reported skill improvement and updating needs among their managerial staff. In the most recent assessment by BIS, many British managers are found to lack key skills, to fail to use their skills strategically, and to face inadequate training provision. Specific problems included gaps in managers' awareness of the value of management skills or of management training, their ability to self-assess their capacities, and their knowledge of many good management practices (BIS, 2012a, 20-21; Bloom and van Reenen, 2010; Bloom et al., 2011).

While skills are on average relatively low in the UK compared to more innovative and productive economies, there is little or no evidence that this takes the form of systematic skill shortages in the form of skills-related recruitment difficulties or internal skills gaps. The latest evidence for the UK in 2013 is that only 4% of firms reported vacancies that were hard to fill for skills reasons at a given point in time while only 15% of firms reported internal skill gaps of any kind (workers lacking full proficiency in their jobs). Overall, internal skill gaps concerned only an estimated 5% of the total UK workforce (Winterbotham et al, 2014). Both of these measures of shortage are partly linked to the large proportion of UK firms that do not have high skill requirements because, as noted in Section 2, they tend to be engaged in low-skill low-innovation activities. Thus, the real skill problems for the UK concern the overall skills deficit relative to other more productive and innovative nations.

How far does employer-provided training in the UK go towards rectifying this overall skills deficit? Much of the criticism of existing employer training provision over the past 20 years has focussed on apprenticeships and training for intermediate skill levels. Successive governments have made attempts to revive apprenticeships as a mode of skills development,

following its decline in the 1970s and early 1980s. Apprenticeships compete as a lifecourse choice with going to university, however, and the decision to allow and favour the expansion of higher education in the late 1980s and early 1990s was never going to encourage the apprenticeship route. Now that higher education has become relatively much more expensive, renewed attempts have been made to encourage apprenticeships, as will be described in Section 4 below. However, while the rhetoric typically refers to the problem of persuading bright young people to choose the vocational route, in reality the constraint is on the demand side with applicant numbers for good quality apprenticeships far exceeding the number of trainee places.⁷ In fact, much of the investment in apprenticeship has been concentrated, not on the youngest age group, but on those aged over 25, and this type of training tends to be of shorter duration and with more limited content than traditional apprenticeships (see Section 4).

The picture of training in the workforce as a whole is also not encouraging. In the 1990s and up to the early 2000s there was an increasing trend in the participation rate in job-related training in the UK, reaching a peak of 15% of employees in 2001. The subsequent decade saw a reversal, with participation falling to 13%. Moreover, underneath these changes there was also an ongoing substantial decline since at least the mid-1990s in the duration of training episodes. In the mid 1990s about a third of all training episodes lasted less than a week; by 2012 this proportion had risen to one half. The net effect of these changes is that the average volume of training – in terms of days per employee – is estimated to have fallen by about a half between the mid 1990s and 2012 (Green et al., 2013). This decline took place across the board, but was most marked for those in younger age groups, those at lower levels of prior education, and those living in Northern Ireland. Relative to comparator countries in the OECD, the short duration of non-formal training is also in evidence, with the result that the volume of non-formal training per employee is middling, with several countries providing substantially more training, including notably the United States, Spain, the Netherlands, Denmark and Japan (Green, A. et al., 2014).

There is little or no evidence that falling training volumes in Britain derive from training barriers (that is, where firms would like to train more but face rigidities in the training market). Successive Employer Skill Surveys have found that where firms do report doing less

⁷ By ‘good quality’ apprenticeships, we refer to those providing a substantive training of two years or more and leading to a recognised membership of, and identification with, an occupation. For information on highly regarded apprenticeship schemes having to turn away large numbers of applicants for training places, see: <http://www.telegraph.co.uk/finance/jobs/8710305/School-leavers-scramble-for-apprenticeships.html>

training than they would have preferred, the main reasons for this shortfall tend to be internal to firms (such as a perceived lack of funding and time) rather than external barriers such as insufficient suitable training providers (Hillage et al, 2002; Winterbotham et al, 2014). Thus, in the absence of any evidence of growth in the incidence or importance of external barriers to training, the falling volume of employer-provided training since the 1990s implies that there has been a decline in employer demand for the skills which can be developed through training (even if some firms have been increasing the efficiency of their training, by targeting their expenditures more closely to their skills needs (Felstead et al., 2012)). To some extent firms may have been able to deliver skills development through careful organisation of work patterns to ensure transfer of technical skills and knowledge: there is indirect evidence of small increases in the extent to which jobs are requiring workers to "learn new things" in the course of their work (Green et al., 2013). Nevertheless, it is hard to avoid the conclusion that the magnitude of the fall in employer willingness to provide training – especially long-duration training -- is a symptom of an economy on a relatively low-innovation trajectory.

Low levels of training are sometimes attributed to the deterrent effect from the risk of employees quitting, taking with them the transferable skills they have acquired for the benefit of another employer. But for many UK managers low training is embedded in a productive model that lacks innovative ambition; in addition, managers with a short-termist perspective are thought to prefer to train less when faced with uncertainty about the effectiveness and value of training investments, in effect making sub-optimal choices (Green, 2013: Ch 5-6). It is likely that this 'management failure' is itself linked to the deficit in management skills noted above, though there have been no formal studies to date that have investigated the association. In the Management Practices Survey data, UK managers' skills in managing human capital were substantially exceeded in Sweden, the United States, Japan and Germany, roughly equivalent to those in France, and in excess of those in Italy, Poland, Portugal, Ireland and China.⁸ It is unlikely to be a coincidence that the countries with high managerial skills for managing human capital also score highly in international comparisons of formal and informal training.

Our overall judgement from this evidence is that training policy in support of a new industrial strategy must recognise that the main UK skills problem is not an unmet demand for skills; rather, it is the relatively low employer demand for skills. Although training policy should

⁸ Authors' calculation from published data, at http://worldmanagementsurvey.org/?page_id=183 (read 23/12/2013).

address skill gaps, shortages and training barriers where they are found to exist, just bridging those gaps will not be sufficient to provide the skills needed for a more innovation-intensive industrial strategy. The isolated, supply-side skills policies of the past have been constrained, in part as a consequence of the neo-liberal approach to policy-making which has eschewed most forms of intervention in employer decision-making. The introduction of a successful industrial strategy would, however, directly address the issue of demand, and with it immediately raise the stakes for skills strategy. Indeed, what is needed is for a skills strategy and an industrial strategy to be conceived together as mutually reinforcing, ideally as an integrated whole. If training policies are not developed to start to meet the increasing demand for innovation-related skills, a well-intentioned industrial policy could be undermined by the historical weaknesses of the industrial training system. We turn next, therefore, to a review of current training policies, prior to a consideration of principles for the development of a training policy that is fit for a new industrial strategy.

4. Existing policy and innovation skill requirements

For the last 25 years skills policy in Britain has been dominated by support for the expansion of higher education, with higher education participation rates in England, for example, rising to approximately 38% of the 17-20 year old age group in 2011-12.⁹ Under both the Coalition government and its Labour predecessor, two strands of higher education policy sought to influence the development of innovation-relevant skills:

- (1) efforts to protect and enhance the provision of courses in Science, Technology, Engineering and Mathematics (STEM) subjects
- (2) programmes and initiatives designed to enhance the teaching of ‘employability skills’ such as communication, numeracy, information technology, problem-solving and team-working skills which are seen as enhancing both the immediate work-readiness of graduates and their longer-term career prospects

Partly in response to some employers’ claims about STEM skill shortages, some STEM subjects are now classified as ‘strategically important and vulnerable’ subjects by the Higher Education Funding Council for England (HEFCE) and have therefore been given extra funding support.¹⁰ Part of the problem perceived by STEM employers is that a large and apparently growing proportion of STEM graduates work in non-STEM jobs and industries (Bosworth et al, 2013). However, from the perspective of innovation-related skill requirements across the UK economy, this can be seen as diffusing graduates who, by dint of their studies in STEM subjects, are widely seen as possessing desirable skills in mathematics and in ‘logical approach[es] to solving problems’ (BIS, 2011: 7). If such skills are in short supply among the wider pool of graduates, this must partly reflect the fact that STEM subjects absorb a high proportion of those entrants to UK universities who have studied maths beyond the age of 16. Indeed, England in particular is conspicuous by international standards for the relatively large proportion of school pupils who abandon maths study at that age (Hodgen et al, 2013).

In the case of support for employability skills development in higher education, many of these generic skills (as discussed in Section 2) are considered to be highly relevant to

⁹ Source: Statistical First Release on Higher Education, 24 April 2013, Department of Business, Innovation and Skills (provisional estimates).

¹⁰ For details of HEFCE support for subjects deemed to be strategically important and vulnerable, see <http://www.hefce.ac.uk/whatwedo/crosscutting/sivs/>

innovation in different workplaces and industries. However, empirical evidence on the effectiveness of different kinds of employability skills initiatives in higher education suggests that structured work experience is more likely to have positive effects on graduates' employment prospects than is the case for university departments' efforts to develop employability skills in classroom settings (Mason, Williams and Cranmer, 2009). These findings serve as a reminder that many relevant employability skills are probably best learned in workplaces rather than through full-time education courses.

This point is also relevant to the development of innovation-relevant skills at intermediate level. The overview of job-related training in the UK presented in Section 3 suggests that a sizeable proportion of UK employers recognise the value of employment-based training to help upgrade the skills of adult employees. However, much of the training provided by UK employers is relatively short in duration and furthermore is unable to build on prior apprenticeship training in the same way as is possible for employers in countries with well-established apprentice training systems such as Germany, Denmark and Switzerland.

A defining characteristic of 'apprenticeship training' is that it combines employment-based training with part-time attendance in vocational education classes or workshops related to the field of training. Under both the Coalition and previous Labour governments, apprentice training levels have grown rapidly across the UK in recent years. For example, in 2012-13 some 510,220 people started apprentice training in England, up threefold in ten years (Table 4.1). More than half (57%) of English apprentice trainees were aiming for NVQ Level 2 qualifications while the remainder were aiming for Level 3 or higher qualifications (Table 4.2). The ratio of Level 2 to Level 3 apprentice starts in Wales is similar to England;¹¹ in Scotland most people starting on the Modern Apprenticeship programme have been aiming for Level 3 qualifications as it is only recently that Level 2 Modern Apprenticeship frameworks have begun to be approved in Scotland.¹²

As shown in Table 4.1, much of the growth in apprentice training in England has occurred in service sectors such as information and communication technology, health, public administration and care and business, administration and law which had little or no previous

¹¹ <http://wales.gov.uk/docs/statistics/2011/110427sdr682011en.pdf> (Table 4)

¹² <http://www.skillsdevelopmentscotland.co.uk/media/141308/ma%20breakdown%20-%20all%20scotland.pdf> ; http://www.alliancescotland.org/NewsEvents/News/100902_TerminationOfSkillseekers.aspx

tradition of apprenticeship training. At the same time apprentice training completion rates have risen substantially and the proportion of trainees aged 19 or older has grown. Thus, by some criteria – especially growth in numbers and the extension of Apprenticeships to non-traditional sectors – the apprentice training system in England and the UK as a whole has performed well in recent years. However, in spite of the recent growth in trainee numbers, apprentices remain a substantially smaller proportion of employees in the UK than in many Continental European countries (Steedman, 2010). This disparity remains even though the UK total includes a high proportion of trainees aiming for NVQ Level 2 qualifications who would not be classified as apprentices in Continental Europe. It is estimated that only about a third of Level 2 Apprentices progress to Level 3 training (Skills Commission, 2009). Furthermore, in the absence of statutory regulation of training content, there are marked variations between different sectors in the amount of on- and off-the-job training and related vocational education that apprentices receive, with particular concerns (as expressed in the Richard Review of Apprenticeships) that some training under the ‘apprenticeship’ heading for older workers in their existing jobs has amounted to little more than short-duration skills updating or accreditation of existing skills (Richard, 2012).

Table 4.1 Apprenticeship Programme starts, England, 2012-13, analysed by sector subject area and rate of growth since 2002-03

Sector subject area	Total	Percent of total	Percent change since 2002-03
Agriculture, Horticulture and Animal Care	7090	1	106
Arts, Media and Publishing	1120	0.2	833
Business, Administration and Law	160410	31	335
Construction, Planning and the Built Environment	13730	3	-13
Education and Training	8050	2	na
Engineering and Manufacturing Technologies	66410	13	118
Health, Public Services and Care	123370	24	562
Information and Communication Technology	14120	3	193
Leisure, Travel and Tourism	14360	3	100
Retail and Commercial Enterprise	101240	20	105
Science and Mathematics	320	0.1	na
Total	510220	100	204

Source: <https://www.gov.uk/government/statistical-data-sets/fe-data-library-apprenticeships> (Apprenticeships by sector subject area, age and level 2002/03 to 2013/14)

Table 4.2 Apprenticeship Programme starts, England, 2012-13, analysed by sector subject area, qualification aim and age group

Sector subject area	NVQ Level 2 (a)	NVQ Level 3+ (b)	All	Under 19	19-24	25+	All Ages
	<i>Percent of total starts</i>			<i>Percent of total starts</i>			
Agriculture, Horticulture and Animal Care	66	34	100	44	36	20	100
Arts, Media and Publishing	21	79	101	54	40	6	100
Business, Administration and Law	57	43	100	17	33	50	100
Construction, Planning and the Built Environment	76	24	100	57	33	10	100
Education and Training	22	78	100	10	18	72	100
Engineering and Manufacturing Technologies	58	42	100	37	32	31	100
Health, Public Services and Care	47	53	100	12	30	58	100
Information and Communication Technology	39	62	100	35	34	31	100
Leisure, Travel and Tourism	53	47	100	39	36	25	100
Retail and Commercial Enterprise	74	26	100	24	35	41	100
Science and Mathematics	22	78	100	41	38	22	100
Total	57	43	100	22	32	45	100

Source: See Table 4.1

Notes:

(a) Intermediate Apprenticeships

(b) Advanced and Higher Apprenticeships, of which 95% are Advanced Apprenticeships, typically aimed at NVQ Level 3 qualifications.

In general, the limited employer commitment to apprentice training in England and the UK as a whole (especially at Level 3) seems to reflect relatively low levels of employer demand for the types of skills that are developed through long-duration employment-based training and related college studies. Thus we return to our assessment of relatively weak employer demand for innovation-relevant skills in the UK which in turn reflects the business strategies deployed by many British firms, many of which do not engage in innovation and have no plans to do so. This is the root source of many UK employers' reliance on short periods of continuing training for existing employees and their reluctance to invest in apprenticeships or any other form of long-duration education and training.

5. A new approach to skills policy development.

Policies designed to stimulate the supply of skills risk failure if they are not accompanied by a strategy to stimulate the demand for skills. Individuals may become disillusioned if they do not get to use the skills they have acquired, while employers may be reluctant to take up offered support, or inclined to use it inefficiently or merely channel it into their existing training plans ("deadweight loss"). However, in the context of a new industrial policy designed to increase innovation levels in the UK economy, skills policy must indeed address the new demands that will follow for innovation-relevant skills. . A supply-side failure, in this scenario, would be manifested in rising skill shortages and skill gaps, which if sufficiently dire would lead to the collapse of the industrial strategy. It follows that policy development and support for training and education should go hand in hand with the emergence of new industrial policy.

The basis for a new approach to skills policy goes beyond the traditional case derived from conventional economics. The latter, conventional, philosophy advocates that employers should be left entirely on their own, in negotiation with their employees, to manage their employees' skills development, except where there is "market failure". The latter arises where, owing to rigidities and imperfections, other employers are able to benefit from the skills training an employer provides. Imperfections include mobility restrictions, and institutional constraints on wages. In theory, then, employers are incentivised to pay for the development of transferable skills, but not enough. Meanwhile, employees are also constrained from funding their own skills development by restrictions in the finance market. Thus conventional economics yields a case for social intervention to support skills development in workplaces. But the case is limited because, in practice, economists have found it hard to estimate the extent of market failures: the "training externality" is a valid theoretical construct but not something that has been quantified and found useful in driving training policy (Green, 2013: 143-145; Keep, 2006); meanwhile, scarcity of evidence about the externalities from higher education may have contributed to acceptance of the case for shifting the cost to students.

The case for social intervention in workplace skill formation is, however, supplemented by management theory, which recognises the agency of managers, and the salience of culture and strategy in determining employer behaviour in an uncertain economic environment. In this approach, the conventional economist's assumption that firms are at their "production

possibility frontiers" (where no outcome can be improved without a loss of some other outcome) is jettisoned, and it is recognised that there is a spectrum of firms with differing overall strategies, heterogeneous management skills, and accordingly differing approaches to skills development (Green, 2013).

This broader intellectual underpinning for an expanded skills policy is also consistent with the need for the skills and industrial policies to be integrated. Thus, as we have argued above, the skills policy should be focused on expanding the capacity of firms to be innovative. The strategy will, in effect, be addressing simultaneously the supply and demand for skills, attempting to coordinate the two through a series of market-supplementing interventions.

To what extent could a new strategy build on existing policies on training? Are the latter at all likely to stimulate a higher level of employer demand for skills? In a 2013 overview of government training policy with the title 'Rigour and Responsiveness in Skills', the key priorities are defined in terms of raising teaching and learning standards in further education colleges; reform and simplification of vocational qualifications; increased support for training of unemployed people; and increased employer flexibility in setting apprentice training standards and choice of training providers (DfE/BIS, 2013). Among other things this policy document announces plans to reduce variation in the quality and value of different apprenticeships and ensure that apprentices reach minimum standards in generic subject areas such as English and maths, thus recognising some of the criticisms of the recent expansion of UK apprentice training made by independent observers (for example, Fuller and Unwin, 2008, 2010; Richard, 2012).

On the face of things, the increased emphasis on employer flexibility in setting apprenticeship standards seems to accept current levels of employer demand for skills without recognising the problems created by the relatively low level of that demand in the majority of UK firms. However, elsewhere in the 2013 training policy document, there is explicit support for funding of a new round of Employer Ownership Pilots (EOPs) which will cohere with plans announced in 2012 for a somewhat more active approach by government to industrial policy. Among other things, it was proposed to develop collaborative strategic partnerships with key sectors that are identified as having good prospects for increasing innovation, productivity

and employment in the future (BIS, 2012b).¹³ This EOP funding is expected to include, for example:

‘large cross-sector and supply chain collaborations to tackle emerging skills needs in industrial strategy sectors; and innovative new approaches to addressing SME needs in localities..... [There will be] a focus on collaborative projects, including promoting industrial partnerships, which will be new employer-led groupings that will take end-to-end ownership of the skills agenda in their sectors. We are particularly keen to see these partnerships forming in sectors which are priorities for the industrial strategy’ (DFE/BIS, 2013: 35-36)

In the present British context of limited employer investment in innovation and relatively low employer demand for skills, these are ambitious objectives but they are welcome in principle. In further developing policy to achieve the integrated objectives of expanding skills demand and supply, three balances will need to be respected: between technical and generic skills, between graduate and intermediate skills, and between initial and continuing training.

The mix of technical and generic skills

Public debates surrounding the skills needed for innovation typically emphasise technical skills and knowledge in key areas of science and technology. However, the evidence reviewed in Section 2 shows that, in addition to technical and practical skills, a wide range of generic skills such as mathematical, communication, problem-solving and managerial skills are needed to support innovation in different industries. In the British context one particularly important pre-condition for higher levels of innovation is likely to be improvements in mathematical skills among many different sections of the workforce. International comparisons show that numeracy proficiency in England and Northern Ireland is significantly below the OECD average (Section 3). This is highly relevant to innovation because of the apparent links between mathematics study and the development of sought-after generic skills such as logical thinking and problem-solving skills. As discussed above, existing employer demand for mathematical skills is already high enough to have contributed to perceived shortages of STEM graduates by some employers, and it seems likely that employer demand for mathematical skills will increase still further if industrial policy is successful in stimulating higher levels of innovation. Accordingly, renewed attention needs to be paid to

¹³ Specifically, the ‘key sectors’ identified in BIS (2012b) are automotive; aerospace; life science (health / agri-tech); offshore wind; oil and gas; nuclear; construction; education; professional business services; and information economy. See also Vince Cable, Speech at Imperial College, 11 September 2012, ‘Industrial Strategy – Cable outlines vision for future of British industry’, <https://www.gov.uk/government/speeches/industrial-strategy-cable-outlines-vision-for-future-of-british-industry>.

improving mathematical skills at all levels, including steps to prevent school and college students from abandoning maths study at the relatively early age of 16.

The mix of graduate and intermediate skills

In our review of evidence on innovation-related skill requirements, we have also emphasised the need for an appropriate balance between graduate and intermediate skills. In recent years this issue has arisen in a number of industries in the UK where the graduate share of employment has increased sharply and yet employer demand for associate or ‘para’ professional and technician-level skills remains strong, for example, health services, financial services and some branches of advanced manufacturing such as aerospace and innovative areas of electronics and chemicals (Skills for Health, SEMTA and Cogent; 2010; SEMTA 2009). This development reflects the need, even at relatively high skill levels, for the mix of skills to include practical skills developed through employment-based training as well as skills and knowledge acquired in classroom settings.

International comparisons suggest that the UK may have something to learn from the ways that other countries address the need for different types of skill at the upper end of the skills spectrum. For instance, in Germany, Switzerland and Denmark, there are long-established graduate-level courses of a practical or occupation-specific nature which have few parallels among British university courses. In Germany graduates from *Fachhochschulen* (‘universities of applied sciences’) represent between 40-50 percent of all graduates. In Switzerland *Fachhochschulen* accounted for 35 percent of students in higher education in 2009. In Denmark holders of ‘professional Bachelor's degrees’ from colleges offering ‘medium-cycle’ higher education represent more than 60 percent of all graduates.¹⁴

An alternative approach is found in France where two-year higher education courses lead to technician-level qualifications such as the BTS (*Brevet de technicien supérieur*, Advanced Technician Certificate) and the DUT (*Diplôme universitaire de technologie*, University Technical Diploma). These provide clear pathways so that students completing those courses can choose between entering employment as technicians or going on to study for Bachelor or

¹⁴ Estimates of the mix of graduates in Germany derived from Mikrozensus, 2004; estimates of Swiss student numbers in 2009 derived from Office fédéral de la statistique (<http://www.bfs.admin.ch>); Danish estimates of graduate shares derived from Statbank Denmark database for 2008.

higher degrees. Taken together, enrolments on these courses account for about 15 percent of all higher education enrolments in France.¹⁵

Similarly, in the United States two-year higher education qualifications (Associates degrees) serve as a potential stepping-stone to either intermediate-skilled employment or to further study to Bachelor degree level. By 2000 an estimated one in five people holding Bachelor degrees had started as students in community colleges and other ‘two-year institutions’ (Bailey et al, 2004). In 2005 about 40 percent of all students enrolled in post-high school education in the US were at colleges of this kind, up from 27 percent in 1970 (Marcotte, 2006).

In the UK context where Foundation degree and Higher National courses (typically requiring two years of study) are already in place, we suggest that it is the French and US models of intermediate qualifications serving as stepping-stones towards Bachelor degrees which provide most food for thought for policy-makers. However, the numbers of UK students enrolled on higher education courses at this level are proportionately much smaller than in France or the US. Although Foundation degree student numbers in England rose steadily from 2002 they peaked in 2009/2010 and declined to only 13,000 in 2012/2013 (HEFCE,2014), representing about 3% of all higher education enrolments in the UK. Higher National Certificate or Diploma enrolments account for a further 2 percent of total higher education enrolments (Mason, 2010). Any expansion of course provision at this level could usefully be integrated with Higher Apprenticeships. About half of all UK-domiciled students on Foundation degree and Higher National courses in 2008 were studying part-time, and a proportion of these students were also engaged in Apprentice training. As yet, the numbers of UK apprentices being supported by their employers to progress to higher education are relatively small but recent case studies of employers who do provide such support found that the perceived benefits – such as development of youthful expertise and improved staff retention – outweighed the costs so far as these employers were concerned (Kewin et al, 2011).

¹⁵ <http://www.education.gouv.fr/pid316/reperes-references-statistiques.html>

The balance between initial and continuing training

Another balance at issue concerns the extent of support for initial training and ongoing training throughout a working career. A case might be made that, with either a sufficiently transformed and broad apprenticeship training or a training through higher education, the large majority of employees can be equipped to learn further and develop their skills through experience in their workplaces. In Germany, with a well-developed apprenticeship system, ongoing training through the lifecourse is not especially high, arguably because the need is lower. We would advocate the continued development of a high quality apprenticeship system, which would become more viable with an accompanying industrial strategy inducing more employers to participate. Consideration needs also to be given to the development of Higher Apprenticeships as a serious alternative to full-time study at university. In parallel, to enable higher education to take place alongside work, we join with others in advocating that part-time study should be made more attractive. However, given the relatively large proportion of the 2030 workforce which is already in employment, it would not be helpful to innovation performance to rely mostly on reforms to initial training and education reforms. For the foreseeable future policies need to pay at least equal attention to the continuing training needs of adult workers already in employment.

No one policy is going to be adequate for the ambitious objective of upskilling the workforce alongside a transformation of innovative capacity. A number of policies for promoting continuing training have been under consideration by the UK Commission for Employment and Skills, some of which would be of value in a training policy for an innovative industrial strategy (Cox et al., 2009; Stanfield et al., 2009; Forth et al., 2011; Gospel, 2012; Cox et al., 2013; Tamkin et al., 2013; Cox et al., 2013; UKCES, 2013). One set of potential policies is designed to make skills development and utilisation more cost-effective, such as inter-employer networks (e.g. group training associations), government subsidies or tax breaks for training, or improvements in the design of public training programmes. To achieve the latter, the method has been to put the employer in the driving seat (promoted as championing "employer demand"). But as we have noted, it will not be sufficient to rely on existing levels of employer demand for skills. Instead, additional policies are needed which help to raise employer demand for skills and training, for example, policies which involve placing regulatory requirements on employer decision-making, such as enacting employee rights to training time, industry levy systems, occupational licensing and public procurement policies,

and industry-level statutory regulation. In all such approaches to policy-making, an important factor will be the extent to which the policy fosters employer learning and awareness of the benefits of skills development.

In selecting the mix of such policies, another factor should be the extent to which each can be embedded in the emerging industrial strategy. For example, most firms with innovative potential but little or no prior track record in innovation will need external advice and support if they are to stand a chance of succeeding in new and unfamiliar markets. Well-funded regional agencies would be best placed to identify firms with such potential and help broker relationships between these firms and Research and Technology Organisations and universities, with the aim of helping firms fill gaps in their skills and knowledge. We advocate that training support policies should be integrated where feasible with new regional development policies of this kind.

6. Conclusion: the need to embed skills in an industrial strategy

There is a tendency for researchers and policy advisers in the world of skills to become so totally committed to their object of study that skills come to be regarded as a panacea for economic and social problems. Among the training and higher education community, debate becomes centred on supply-side skills issues, ignoring the problem of low demand for skills. Issues such as rising overeducation, or relatively low productivity, do not form part of the conversation. Meanwhile, for businesses and for researchers and policy-makers in other fields studying research and innovation, the problem of skills hides down the agenda as a minor and easily-resolved problem. We think that both are wrong. In this paper we have argued that:

- Innovation should be an essential part of any new industrial strategy, and there should be particular emphasis on policies designed to identify and support firms which currently do not engage very much in innovation but have the potential to do so..
- Innovation requires skills, as evidenced by survey work and estimates of returns to skills investments, and of the links between firms' innovation and workforce skills. While higher-level skills figure in most discussions of innovation, intermediate-level skills are also going to be important. No single type of skill is required: rather, innovation calls for a wide range of skill types.
- Britain is suffering from a skills deficit, with relatively low levels of skills demand and supply, which will need to be addressed as an integral part of the new industrial strategy. Increasing skills, in the absence of policies to raise skills demand, is a limited strategy.
- However, an expansionary skills strategy becomes especially important when an industrial strategy is in place. It should build on elements of existing policy which emphasise engagement with, and support for, that section of employers who have the potential and market incentives to become innovative. The policy needs to be balanced in three dimensions: between technical and generic skills, between higher and intermediate skills, and between initial and continuing education and training.
- A culture of evaluation and of selected policy-learning from other countries should prevail. While it is not necessary to invent new policies for training, an imaginative selection of policies can be used, drawing on existing and prospective studies.

Wherever feasible a training strategy should be embedded in innovation support and regional development policies.

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